Report of an Independent Federal Review Team on Management of Dredged Material Disposal Sites at the Mouth of the Columbia River, Oregon/Washington

19 October 2001

ACCEPTANCE OF REPORT
OF INDEPENDENT REVIEW TEAM

1. On September 18, 2001, I commissioned an independent team of experts to review the practices of the Portland District, U.S. Army Corps of Engineers in managing ocean dredged material disposal (ODMD) sites in the vicinity of the mouth of the Columbia River. I specifically requested the team to

a. Review the Corps' site management practices at site E.

b. Determine whether any modifications to our site management practices could improve our ability to meet our target.

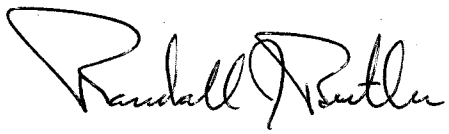
c. Recommend modifications or improvements to our site management for all disposal actions in the ocean and Section 404 disposal sites.

d. Provide any other recommendations that the team deems necessary.

The team completed their review and submitted their report to me on October 19, 2001; an addendum to the report was submitted on November 9, 2001.

2. I accept for consideration the findings and recommendations in the report pertaining to the technical aspects of site management. I have authorized immediate implementation of particular recommendations, and I am continuing to evaluate the remaining recommendations for consideration of future action.

3. I do not accept the findings and recommendations pertaining to the stipulations and orders (referred to in the report as "Settlement Agreement") in Columbia River Crab Fisherman's Association, et al. v. Caldera, et al., Civil Action No. C98-0359D (dismissed in 1998). The team of experts was not tasked to review the Settlement Agreement and the interpretation of that agreement falls outside of the team's expertise. Thus, any opinions, conclusions or interpretations expressed in the report regarding the Settlement Agreement, its legal effect or representations by the team of interpretations by the Portland District or others do not reflect the views of the United States, including the U.S. Army Corps of Engineers.



9 NOV 2001

RANDALL J. BUTLER
Colonel, EN
Commanding

9 November 2001

Errata:
Report of an Independent Federal Review Team on Management of Dredged Material Disposal Sites at the Mouth of the Columbia River, Oregon/Washington

In the 13th bullet of Section III C 1. BACKGROUND INFORMATION, replace the existing bullet with "The wave climate goal is prescribed in site management guidance documents and a Settlement Agreement (SA)."

On the 10th line in the 4th paragraph of Section IV A. OVERVIEW OF SITE MANAGEMENT, change "3.6" to "about 2.3"

On the 4th line in the 1st paragraph of Section IV C 2. DIFFERENT DISPOSAL PRACTICES WERE ALLOWED IN THE SEPARATE ZONES, change "cells (Figure 3)." to "cells (Figure 3) or lanes."

Change the next sentence to begin with "For example in 2000, Site E1…"

In the original October 19, 2001 report, Figure 12 was incorrectly identified as representing wave response to bathymetric conditions for 2000 and thus to compare well with 2000 conditions shown in Figure 11. In fact, however, Figure 12 represented 2001 conditions and the wave approach angles were also different. The attached replacements for Figures 11 and 12 show the results of modeling based on comparable bathymetric and incident wave approach conditions in 2001. The following text changes relate to these replacement figures.

On the 6th line in the 1st paragraph of Section IV F 2. STWAVE MODEL, change "Figure 11." to "Figures 11 and 12."

On the 5th line in the 1st paragraph of Section IV F 3. LIMITED AREA OF INFLUENCE, change "2000" to "2001".

On the 9th line in the 1st paragraph of Section IV F 3. LIMITED AREA OF INFLUENCE, change "Natural accretion on the north portion of Peacock Spit created a potential amplification area much larger than did the bathymetric changes in Site E." to "Natural accretion on the north portion of Peacock Spit created a potential for amplification in the fourth and most northerly area."

On the 5th line in the 4th paragraph, *Multiple models*, under Section IV F 4. RECOMMENDATION TO DETACH CONSIDERATIONS OF WAVE MODIFICATIONS FROM DREDGED MATERIAL DISPOSAL DECISIONS, change "in Figure 11" to "by comparing Figures 11 and 12."

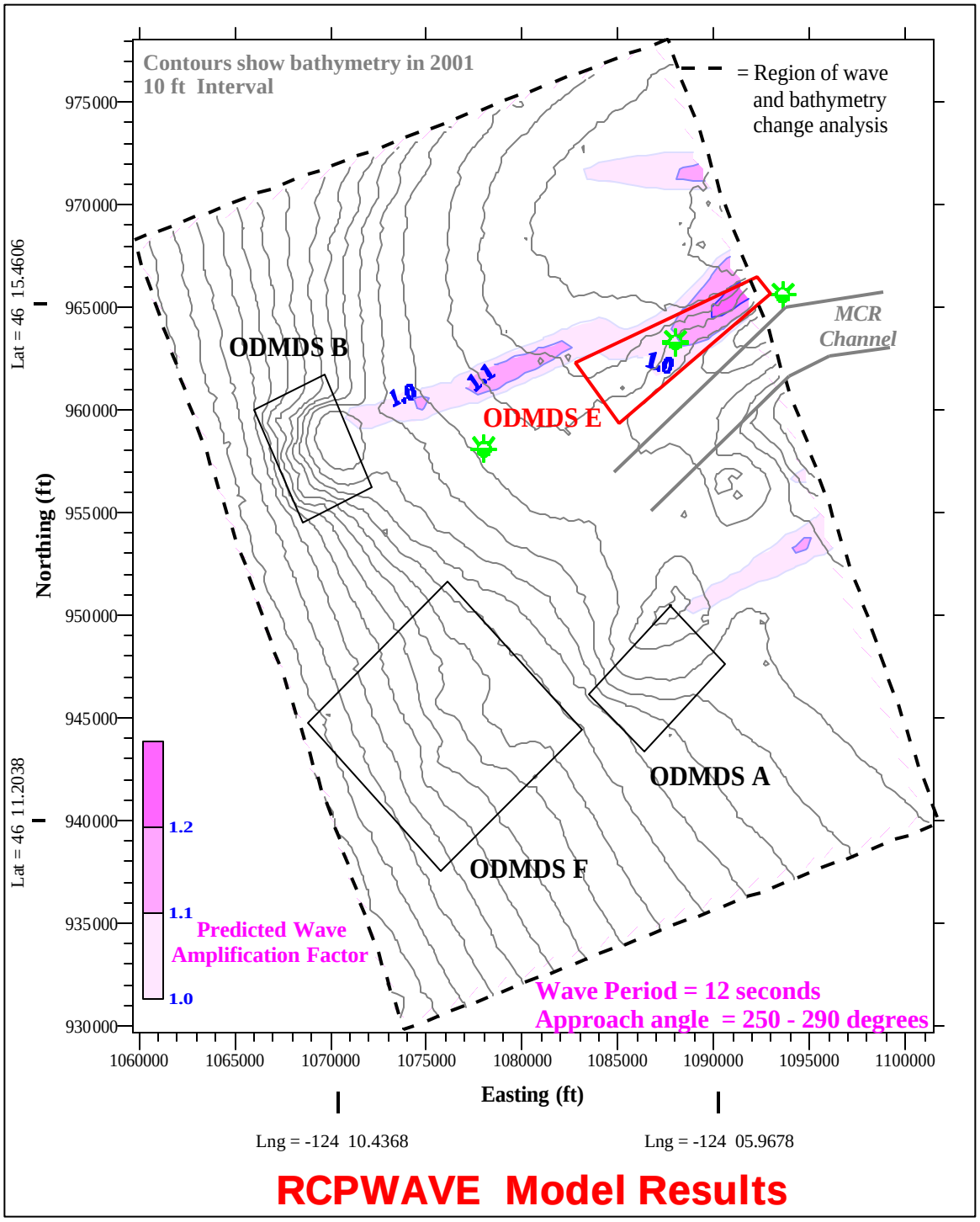


Figure 11. RCPWAVE model estimate of potential wave height amplification in September 27, 2001, above heights that would have occurred if the same incident waves crossed 1997 bathymetry (Figure and modeling by NWP). Note that amplifications between 1 and 1.1 were within the model's margin of error. Using this model, one area within Site E shows a potential for 20 to 30 percent amplification.

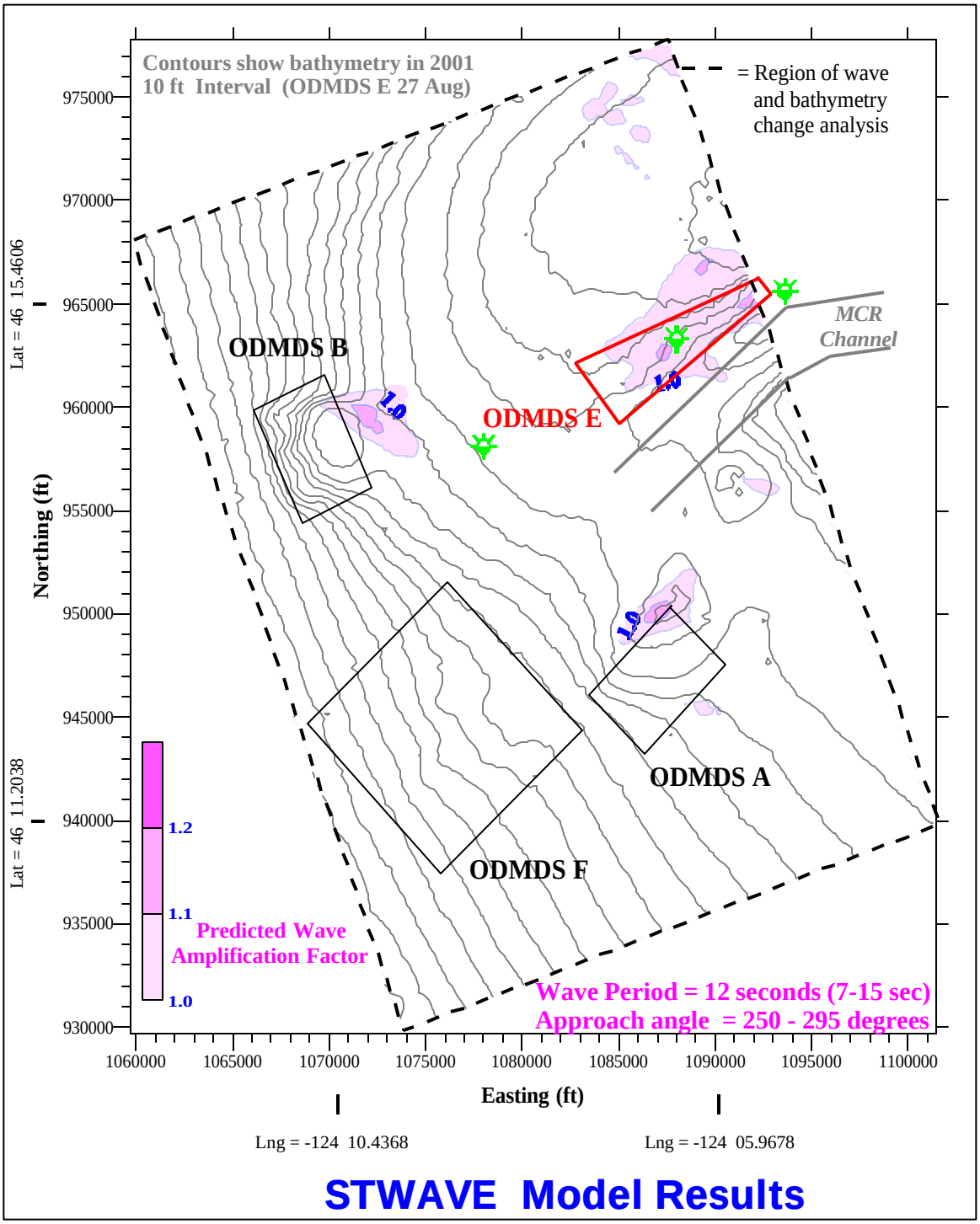


Figure 12. Spectral estimate of potential amplification for comparable conditions to those used with the monochromatic model shown in the previous figure (Figure and modeling by NWP). Note STWAVE indicates less intense amplification than does RCPWAVE. Nowhere do STWAVE amplifications exceed 1.2 (20 percent).

Report of an Independent Federal Review Team on Management of Dredged Material Disposal Sites at the Mouth of the Columbia River, Oregon/Washington

Executive Summary

Two different investigations were initiated following the capsizing of the *Miss Brittany* near the Mouth of the Columbia River (MCR) on August 7, 2001 and two small recreational vessels on the 2001 Labor Day weekend. The United States Coast Guard (USCG) investigated the specific circumstances and causes of the fatal incidents. This Review Team evaluated the federal government's management of dredged material disposal operations in the area. This review emphasizes operations in 2001 that led to increased mounding and the decision to re-dredge Site E. Events were specifically considered in light of the 1998 Settlement Agreement under which the agencies were operating, and further focused on Site E because of assertions that disposal practices there may have contributed to the *Miss Brittany* incident. While the USCG's final findings and report were not complete at the time this report was prepared, the Review Team did interview the USCG officer in charge of that investigation. Though we did not know the conclusions of the Coast Guard's review at the time we completed our report, nothing in our investigation suggested that mounding at Site E could have affected the condition of the waves in the area where the capsizing of the *Miss Brittany* is reported to have occurred, under the northwesterly originating wave conditions present at the time.

Disposal operations in 2001 and communication lapses resulted in more mounding at Site E than in previous years. Ultimately, the Portland District decided to re-dredge some of that material and dispose of it at Site F. However, this is generally undesirable because material removed from Site E is lost to the littoral system, and because Site F has very limited remaining disposal capacity. It has clearly become more difficult to balance the competing management goals at the MCR. Today, overall disposal options for the area have become so limited that the ability to maintain the navigation channel at the MCR is in jeopardy.

The Settlement Agreement stipulates that the District "make every effort...at Site E to avoid disposal in a way that contributes to wave amplification greater than 10 percent". We note that, at every stage, the District's measurements relating to this stipulation were conservative. Nevertheless, wave modeling at the District and independently at the U.S. Army Engineer Research and Development Center (ERDC) indicate that under certain wave conditions the post-placement mound at Site E in August and September 2001 could have amplified wave heights more than 10 percent above the heights that the same deep-water waves would have created in May 1997, the year to which such comparisons are being made. However, the model results show amplification exceeding 10 percent for only a small area under certain incident wave conditions. Furthermore the predicted amplification is temporary because waves and currents are continually dispersing material placed in Site E.

No amount of restriction on Site E usage, short of complete abandonment, would guarantee that disposal plays no part in navigation risks in the vicinity of Site E. At the

same time, even completely abandoning Site E would not significantly reduce risks to vessels transiting the area. In fact, the present restrictions on use of Site E could provide a false sense of security to those traversing the site and thereby increase the already substantial risk faced by boats taking a short cut to the north over Peacock Spit. Reducing present ambiguities in mounding criteria, and using more accurate wave models could increase the accuracy of estimated wave changes but would not reduce the existing dangers of crossing Peacock Spit.

Management of Site E requires the balancing of several competing and sometimes mutually exclusive goals: keeping sand in the littoral system, avoiding mounding/elevation thresholds, seasonally avoiding crab fishery areas, and efficient dredging. Consequences of the trade-offs among these are complex and site management by the agencies to optimize each of these goals is extremely challenging. Management is further complicated by the limited disposal alternatives presently available.

In many ways, the District and EPA are managing the MCR disposal sites well. These agencies clearly expend considerable time and effort managing the MCR project. The level of surveying, modeling, and communication are well beyond what is done for many sites throughout the nation. In view of the incremental adoption of increasingly restricted use of Site E that has occurred over the last few years, the relatively low dispersion during the winter of 2000-2001, and the loss of other disposal options, the Review Team recommends immediately updating the Disposal Site Management and Monitoring Plan, with appropriate involvement of other stakeholders. This should include development of more specific response thresholds (including magnitude and extent or potential changes) and articulation of potential management responses. In the longer run, the proposed permanent disposal site designations should be completed, and additional options should be evaluated to use the large volume of beach-quality sand regularly dredged from MCR to more directly mitigate ongoing erosion of both Peacock Spit and the shoreline.

We recommend several improvements to dredged sediment management for the MCR, including more consistency in disposal placement guidance provided to Corps dredges, having the District receive and review sediment placement positions from all operating dredges, more frequent bathymetric surveys, and quicker processing of survey results. The District should also coordinate with other agencies to improve availability of sea state conditions for the boating public such as web-based wave information or cameras.

I. Introduction

This report presents the findings of an independent Federal Review Team that was created to evaluate dredged material disposal practices and processes at the Mouth of the Columbia River (MCR). The report reviews the background information, synthesizes our observations, and provides commentary and recommendations on various aspects of dredged material management. The findings in this document represent the collective opinion of the Review Team.

II. Purpose of the Review Team

In response to concerns regarding potential impacts of dredged material disposal practices at the MCR, the Portland District (NWP) of the US Army Corps of Engineers convened an independent Review Team with expertise in disposal site management and monitoring and coastal wave dynamics to evaluate these concerns. A primary cause for creation of the Review Team was the fatalities associated with the capsizing of the fishing vessel, *Miss Brittany*, August 7, 2001 in the vicinity of the dredged material disposal Site E, followed by the capsizing of two small recreational vessels on Labor Day weekend near the MCR.

III. Proceedings of Review Team

A. Charge from the District Engineer

The Review Team met with the Portland District Engineer, Colonel Randall Butler, the senior District staff, and North Pacific Division staff on 18 September 2001 to discuss the role of the Review Team. Colonel Butler asked that the Review Team examine any and all information the team felt necessary to investigate MCR management practices. He made all documents and staff available to the Review Team. He asked that the Review Team both identify operations that could be improved and note those that have been done well. Based on these findings, he asked that the Review Team provide recommendations on any aspect of District operations and management that the Review Team believed would improve future operations.

B. Review Team Composition and Background of Members

The Review Team was comprised of four individuals with expertise in (1) ocean dredged material site management, (2) ocean dredged material site monitoring, and (3) coastal wave dynamics. The Review Team was comprised of four members from locations outside of the Pacific Northwest: two from the US Environmental Protection Agency (EPA) and two from the US Army Corps of Engineers (USACE).

Review Team Members and Backgrounds		
Name	**Office**	**Areas of Expertise**
Thomas Fredette, PhD (Review Team Chair)	US Army Corps of Engineers, New England District Concord, MA	Dredged Material Disposal Site Designations, Management & Monitoring
Edward Hands	Engineer Research and Development Center Vicksburg, MS	Coastal Waves, Currents, and Seafloor Responses
William Muir	US EPA Region 3 Philadelphia, PA	EPA's Designated National Ocean Dumping Expert
Brian Ross	US EPA Region 9 San Francisco, CA	Ocean Disposal Site Designations, Management, and Monitoring

C. Activities of the Review Team

The Review Team conducted its investigation using a combination of briefings, interviews, document reviews, and Review Team meetings. These were conducted from 17-20 September 2001. A preliminary findings briefing was held with the District Engineer and senior District staff on 20 September 2001. The Review Team departed Portland, Oregon on 21 September 2001 and continued its investigation reviewing requested documents and speaking with various staff members as needed. The Review Team received all the information that it requested, and believes this information was adequate to evaluate operations at the MCR and to reach the conclusions and recommendations contained in this report.

1. BACKGROUND INFORMATION

The Review Team convened in Portland, Oregon on 17 September 2001 at the USACE Portland District office and began with a series of background information briefings on the dredged material management practices in the vicinity of the Columbia River mouth. These discussions were held with Portland District staff members Eric Braun, Doris McKillip, Hans (Rod) Moritz, and Mark Siipola, USACE Northwest Division staff, Jim Reese, and John Malek, US EPA Region 10 ocean disposal coordinator.

These discussions focused on the use of the multiple disposal sites in the region over the last few years (Figure 1a and 1b) and in particular 2001. The Review Team developed a list of documents and information needs that District and EPA Region personnel readily provided from their files.

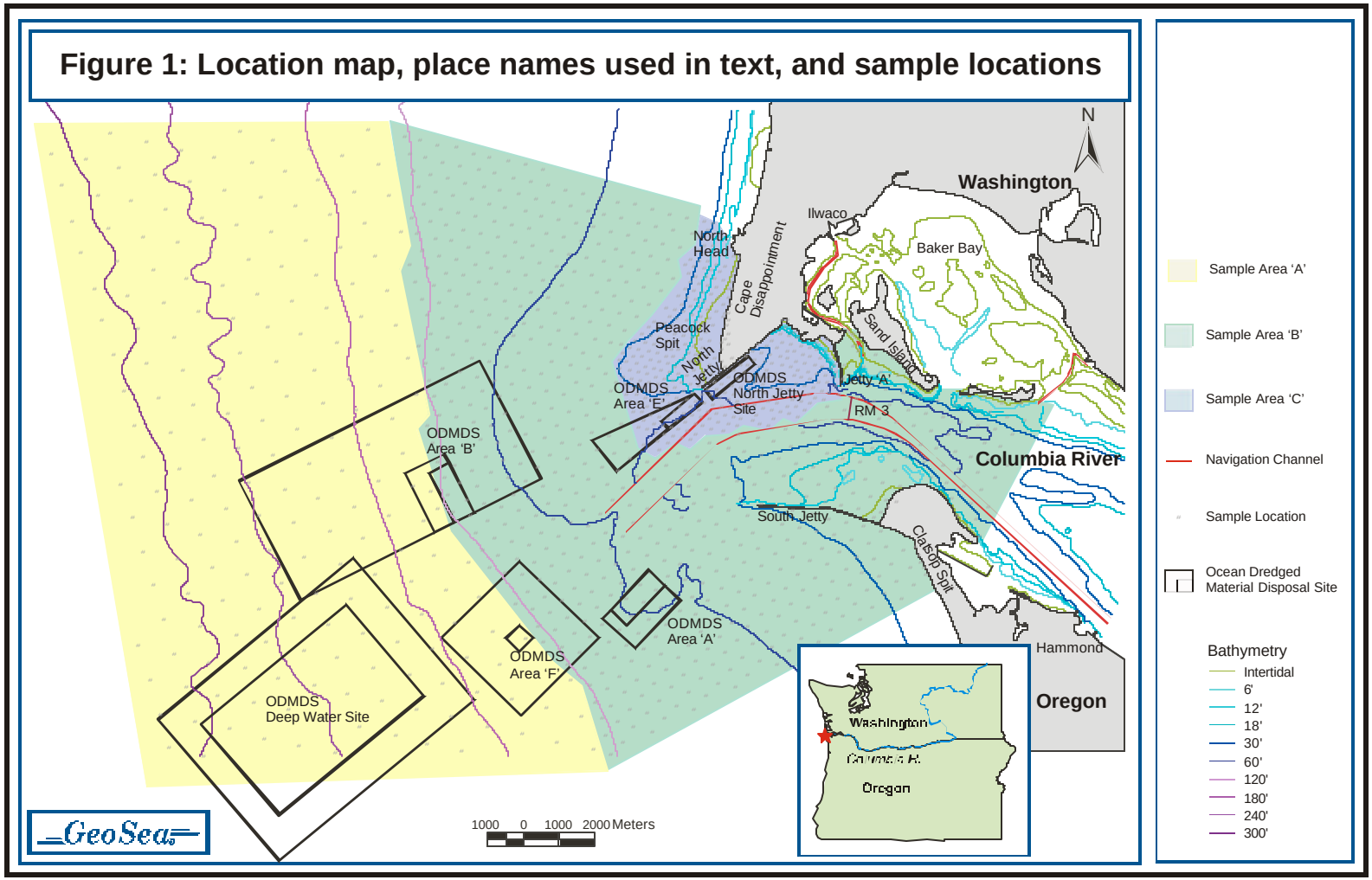


Figure 1a. Map of disposal sites near the mouth of the Columbia River (reproduced from McLaren and Hill, 2001)**.**

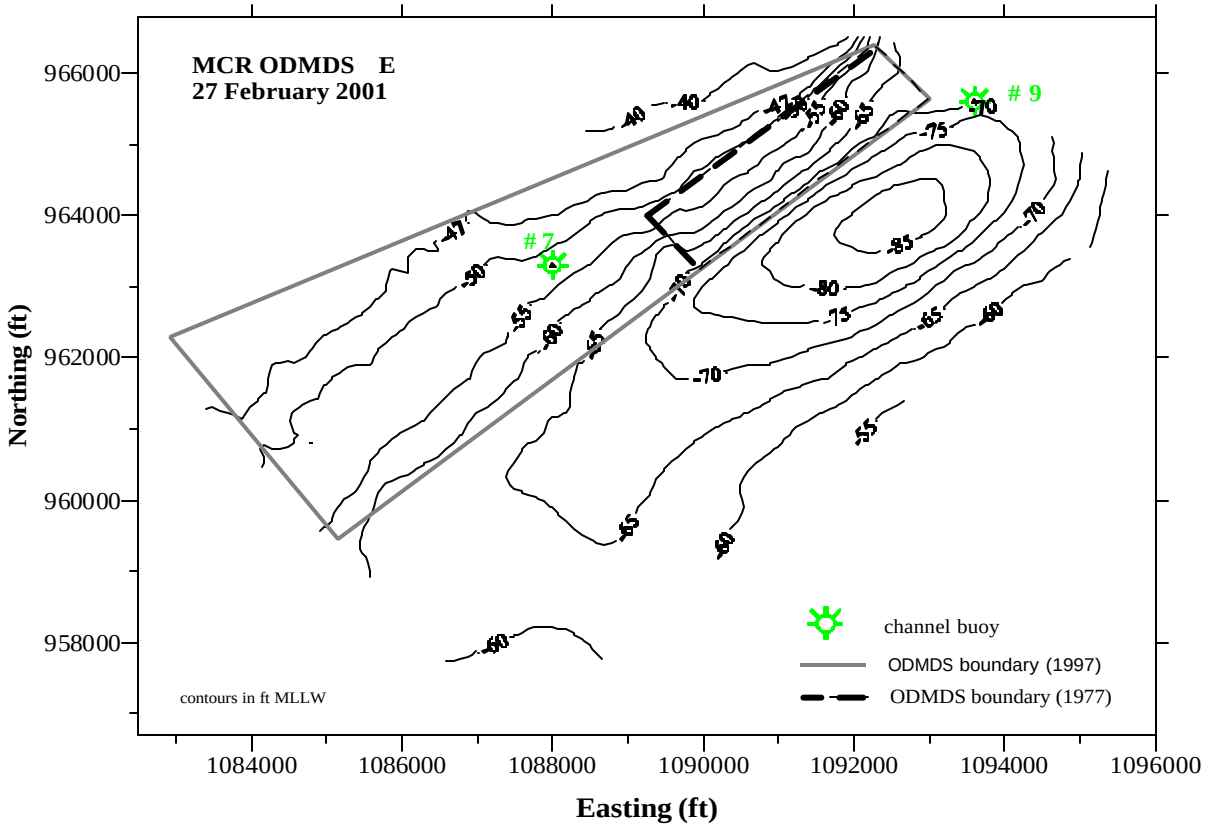


Figure 1b. Site E showing the 102 (1977 boundary) and 103 (1997 boundary) portions of the site.

Key, basic information gained from these background discussions included the following:

* The Columbia River mouth is renowned as one of the most dangerous coastal inlets in the world (USACE 1999).
* Peacock Spit, immediately north of the entrance channel, is the predominant bathymetric feature affecting wave climate in the area.
* For the last century, Peacock Spit has been undergoing long-term erosion; this erosion could eventually jeopardize the integrity of the North Jetty.
* There is an annual need for 4-5 million cubic yards of capacity for maintenance dredged sediment from the federally authorized navigation channel MCR project.
* The optimum time to dredge the MCR project is from June to November because of sea state, river flow conditions, and navigation needs.
* Site E, adjacent to Peacock Spit, has been the primary site used in the past few years (especially since 1997) for placement of dredged sand from the MCR with lesser amounts going to Sites F and the North Jetty.
* Sediments placed into Site E are dispersed from the site over time by waves and currents.
* Site F is close to its maximum capacity and is non-dispersive.
* The North Jetty Site has limited annual capacity (~500,000 cubic yards), but is dispersive.
* Site E is managed to maximize retention of sand in the littoral system, minimize potential to adversely affect wave climate, minimize conflicts with the Dungeness crab fishery and maximize dredging efficiency.
* These site management goals, in part, conflict with one another which requires balancing among them.
* The sand retention goal is prescribed in state water quality certificates.
* The wave climate goal is prescribed in a court mediated Settlement Agreement (SA).
* The fishery conflict goal is prescribed in the same court mediated Settlement Agreement and prohibits placement of sediment in the deeper, westerly portion of Site E after August 15th.
* The District manages contract and Corps dredges with a goal of minimizing sediment mounding within Site E.
* The District conducts bathymetric surveys to assess accumulation of sediment in Site E.
* The District conducts modeling based on the results of bathymetric surveys to predict potential wave amplification by the sediment accumulation.
* Because of its limited annual capacity, the 102 designated portion of Site E is only a short-term and partial solution for managing sediments from the Columbia River mouth.
* Studies are underway by the District and EPA Region 10 to designate additional 102 sites in the region that will adequately serve the long term MCR maintenance needs and address the multiple management goals for the area.
* The District coordinates with EPA and other interested parties through frequent and multiple lines of communication.

2. BRIEFINGS, INTERVIEWS, AND FACT FINDING

Briefings and Interview. Following its initial background briefings, the Review Team requested three specific briefings as part of its investigation. The first was presented by Mr. Hans (Rod) Moritz on bathymetric surveying of the disposal sites and computer wave modeling. The second was with Captains Neal Nyberg and Ron Henry, Masters of the Corps dredge *Essayons*. The third was with Lieutenant Sean Regan, US Coast Guard, who is leading the investigation into the boating accidents that occurred during the summer of 2001 in the Peacock Spit area.

Fact Finding. The Review Team requested numerous documents and information summaries from District staff for review. In addition the Review Team conducted interviews with District staff Mark Siipola, Eric Braun, Doris McKillip, and Rod Moritz, and Mr. John Malek of EPA Region 10. Additional documents were provided to the Review Team, at their request, in the days following the sessions in Portland.

IV. Findings

A. Overview of Site Management

Site E is located immediately west of the North Jetty at the mouth of the Columbia River (Figure 1). This is an extremely challenging area for any size vessel, including large hopper dredges, to operate in. As summarized in USACE, 1999:

> *The Columbia River entrance is characterized by exceptionally strong wave-current interactions. As a consequence, the river entrance has been recognized as one of the most dangerous coastal inlets in the world. The sea state at the river entrance during storm conditions can be characterized by high swells from the northwest to southwest combined with locally generated wind waves from the south to southwest. Such combined seas at the river mouth can be particularly dangerous to the mariner, especially when opposing ebb currents cause dramatic wave growth, steepening, and breaking incoming waves.*

Because of these characteristics, only hopper dredges are feasible for maintaining the federal channel at the MCR, and dredging can only occur during the summer months.

Site E is actually made up of two federally authorized disposal sites that are technically managed separately (Figure 1). The original Site E, which comprises a rectangle in the eastern portion of the area, was designated as a permanent ocean dredged material disposal site in 1986 by EPA, pursuant to Section 102 of the MPRSA. As a permanent, EPA-designated "102 site" this area must be managed in accordance with a Management and Monitoring Plan (MMP) written and/or approved by EPA Region 10. The most recent version of the MMP for this site, dated January 1998, was in force during 2001.

In 1997, the Portland District created an expansion of the original Site E (as well as further expanding Site B) pursuant to Section 103 of the MPRSA. Site selections by the USACE under Section 103 are temporary (not to exceed five years, with one five year extension possible) and for project-specific use. MMPs are not required for temporary "103 sites", but EPA must concur in the USACE's proposed selection of such sites. Among other things, the USACE must establish to EPA's satisfaction that any existing 102 sites in the vicinity are either not available or not sufficient and practicable to use for the project at issue. EPA did participate in development of the 1998 MMP, and that MMP did cover management at both the "102" and "103" portions of the ODMDS.

Every year, on average, about 4.5 million cy of sand are dredged from the MCR navigation channel. Between 1977 and 1987, Sites A and E received most of this dredged material. Beginning in 1988, the USACE voluntarily restricted disposal at Site E to approximately 1 million cy per year based on concerns that deposited material eroding from the site might migrate into the estuary or back into the navigation channel. However, disposal at Site E increased starting in 1998 partially in response to a need identified by requirement of the State of Washington to retain as much sand as possible be retained in the near shore littoral system in order to retard coastal erosion to the north. From 1998 through 2000, an average of approximately 3.4 million cy was placed at Site E each year. In 2001, a total of 3.6 million cy was placed at Site E.

As noted above, there are three other ocean disposal sites in the area. However, Site F (as designated by EPA in 1983 and expanded in 1993) (Figure 1) is now in effect the only other potentially available ocean disposal site because EPA Region 10 has de-activated Sites A and B, in part due to mounding, in 1992/1993. Site F has three key limitations, however. First, it is not dispersive in the manner of Site E, and has limited capacity. Second, it is directly off shore of and in line with the navigation channel, and is where pilot vessels meet incoming shipping. Third, material disposed in this area is likely to be lost to the near shore littoral system. The other available disposal option for some of the material dredged from the MCR federal channel is the recently established site immediately south of the North Jetty. The "Jetty" site is a CWA Section 404 site, rather than an ocean dumping site under the MPRSA, since it is inside the baseline of the Territorial Sea. Material placed at the Jetty site is in part sacrificial sand that helps to protect the North Jetty from being undermined due to erosion. The site has a capacity of approximately 500,000 cy per year.

Potential new sediment management alternatives have been evaluated in a comprehensive EIS (USACE, 1999). This evaluation considered the feasibility of direct upland or beach disposal, estuarine disposal, and continued ocean disposal at various locations. These alternatives were found to be not feasible for a number of reasons, and the EIS proposed action included continued use of a shallow water dispersive disposal site where Site E presently exists (along with continued use of the Jetty site), and establishment of a new deeper water offshore site that would not have the constraints or potential impacts of the previously designated sites including Site F. Retention of sand in the near shore littoral system was identified as one of the main objectives of the overall approach, and hence maximizing the volume of sand that could be disposed at the Shallow Water site plus the Jetty site would continue to be a primary management goal.

Designation of these new proposed disposal sites has been delayed, however, leaving Site E, Site F, and the Jetty site as the only alternatives presently available for management of dredged material from the MCR.

B. 2001 Events

1. Sequence of Events

The Review Team constructed a timeline to better understand the events that occurred at Site E during the summer of 2001 (Figure 2). The events displayed on the timeline are briefly reviewed here and further detail on these events, as necessary, is contained in following sections. The basic management approach reflected in the 2001 timeline is similar to what the District has followed in each of the last several years.

The District first developed their site-use recommendations for the year, based on disposal site surveys from late 2000, in their annual report (USACE 2001) produced in January 2001. Prior to the dredging cycle, another bathymetric survey of Site E was conducted on 30 May 2001. This survey identified areas that had not eroded substantially since 2000, and was therefore the basis for the District's selection of specific "no disposal" areas for 2001 within the overall disposal site. Placement of sediment at the site in 2001 was performed by both a contract and a government dredge. The District provided relatively detailed sediment placement directions to the contractor in Contract Plans and Specifications and required the contractor to (1) survey its portion of the disposal site every 48 hours to avoid mounding and (2) to report their sediment placement positions. The District provided less specific sediment placement directions to the Corps dredge, *Essayons*, through a series of Dredge Orders, and did not require reporting of placement positions. The District conducted periodic surveys of the Site during placement by the *Essayons*, but these surveys were less frequent than those conducted by the contractor.

Sediment placement at Site E began on 2 June 2001 and continued until 14 August 2001. The contract dredge, *Padre Island*, conducted work from 1-3 July until a collision with the #7 channel buoy on 3 July necessitated repairs. The *Padre Island* continued its work from 30 July to 14 August 2001. It placed a total of 820,820 cubic yards in the western portion of Site E. Concurrently, the *Essayons* placed sediment in Site E from 2 June to 3 August 2001. Most of this sediment was placed in the eastern portion of the site. The first of the surveys conducted by the District occurred on 30 June 2001, after the *Essayons* had placed about 900,000 cubic yards of sediment at the site. This survey showed that a mound had been formed in the eastern area of Site E adjacent to where the *Essayons* was placingsand, but it was not reviewed until 12 July 2001 (by which time additional sediment had been placed by the *Essayons*). The *Essayons* was then directed to dispose in the western portion of the site. The District conducted another survey on 19 July which showed the mound height had increased from 30 June. This began discussions of the possibility of re-dredging the sediment mound and placing it at Site F. A 30 July survey showed the mound was eroding with the cessation of nearby disposal. The District continued its evaluation of whether to dredge or monitor the progress of erosion. On 7 August 2001 the fishing vessel *Miss Brittany* capsized

resulting in the loss of life to two crewmen. The District was aware that the *Essayons* would be leaving the Columbia River area soon and decided to dredge the mound at the site as the best course of action. Additional surveys confirmed that this was accomplished. Also, during the entire summer period the District's usual site manager was on a 120 day detail to another portion of the District.

Based upon our investigation we learned that the *Essayons* placed most of its hopper loads around a very localized area where the currents were very strong with the belief that the sediments would be dispersed. While this did not result in shoaling in the immediate placement area, it appears to have resulted in the creation of a mound a short distance away. The District staff were not receiving plots of *Essayons* sediment placement positions and therefore were unaware of this practice.

A detailed review of the Year 2001 management and actual placement at Site E are presented in the following sections.

10/19/01

Task	Start	End
2001 Site-use Recommendations	1/9/01	1/9/01
Sediment Placed at Site E	6/2/01	8/14/01
Contract Dredge Sediment Placement	7/1/01	8/14/01
Buoy Strike/Contract Dredge	7/3/01	7/3/01
Dredge Orders/Corps Dredge (Essayons)	5/31/01	8/15/01
Essayons Sediment Placement	6/2/01	8/3/01
Dredging at Site E by Essayons	7/30/01	8/21/01
Monitoring Surveys by District	5/30/01	12/17/01
Vessel Capsizing	8/7/01	8/7/01
120 Day Detail of Site Manager	5/6/01	9/7/01

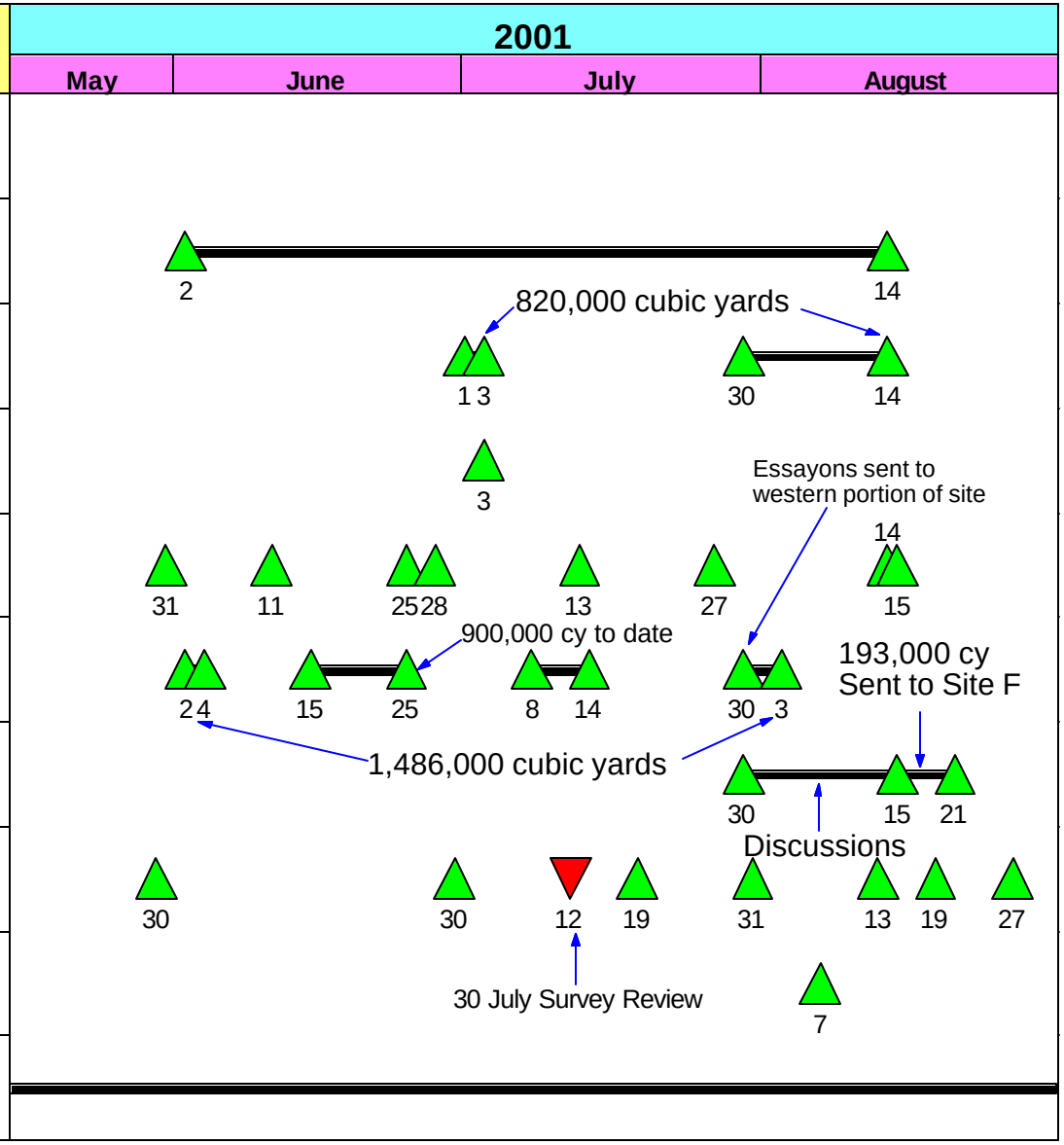


Figure 2. Time line of events in 2001.

2. Factors Contributing to 2001 Mound Creation

The 2001 sediment disposal at Site E did reduce depths more than the District intended. Several factors directly or indirectly lead to this development. They were:

* The lack of *Essayons* sediment placement positions reported back to the District
* The significant time gap of a month before the first bathymetric survey by the District was conducted. By that time about 900,000 cubic yards of sediment had already been placed by the *Essayons*
* The further time gap between the first (June 30) survey and the July 12 report to management of a significant mound
* The second major time lag between the 30 July survey and its review, during which additional sediment was placed by the *Essayons,* contributing to increased mounding
* Detailing of the Site Manager to another portion of the organization during this critical time
* The buoy collision by the *Padre Island* which consumed staff time

This mound had some potential to increase wave amplitude within and possibly some small distance outside of the site under certain wave conditions that are not necessarily frequent nor particularly hazardous. The area of amplification above 10% extends less than 2500 ft outside of the site boundaries in a shoreward direction. Wave amplification is discussed in greater detail in a following section.

C. Dredging and Disposal Specifications

Seasonal dredging of the federally authorized navigation channel at the MCR is carried out by a combination of hopper dredges owned and operated by the USACE, and other private hopper dredges working for the Portland District under contract. Although the USACE and contractor dredges work in the area at the same time and discharge their dredged material at the same disposal site, they operate under separate orders with somewhat different requirements. These differences include: separate zones within the disposal site that they may use during specified periods; the degree to which the District specifies the precise location of discharges within those different zones; the records that the District requires be turned in by the dredgers; and the frequency of condition surveys in the different zones of the disposal site. The USACE versus contractor requirements are discussed in further detail below.

1. Separate disposal zones within Site E were specified for the contractor and USACE dredges

The District specifies separate disposal areas within Site E for the USACE dredge and the contract dredge. In 2001 the eastern zone or E1 was used by the Corps dredge *Essayons,* and the western zone or E2 by the contract dredge *Padre Island* (Figure 3). This is done partly to minimize any operational conflicts that could arise with vessels disposing in the same area at the same time. Since wave and weather conditions at MCR

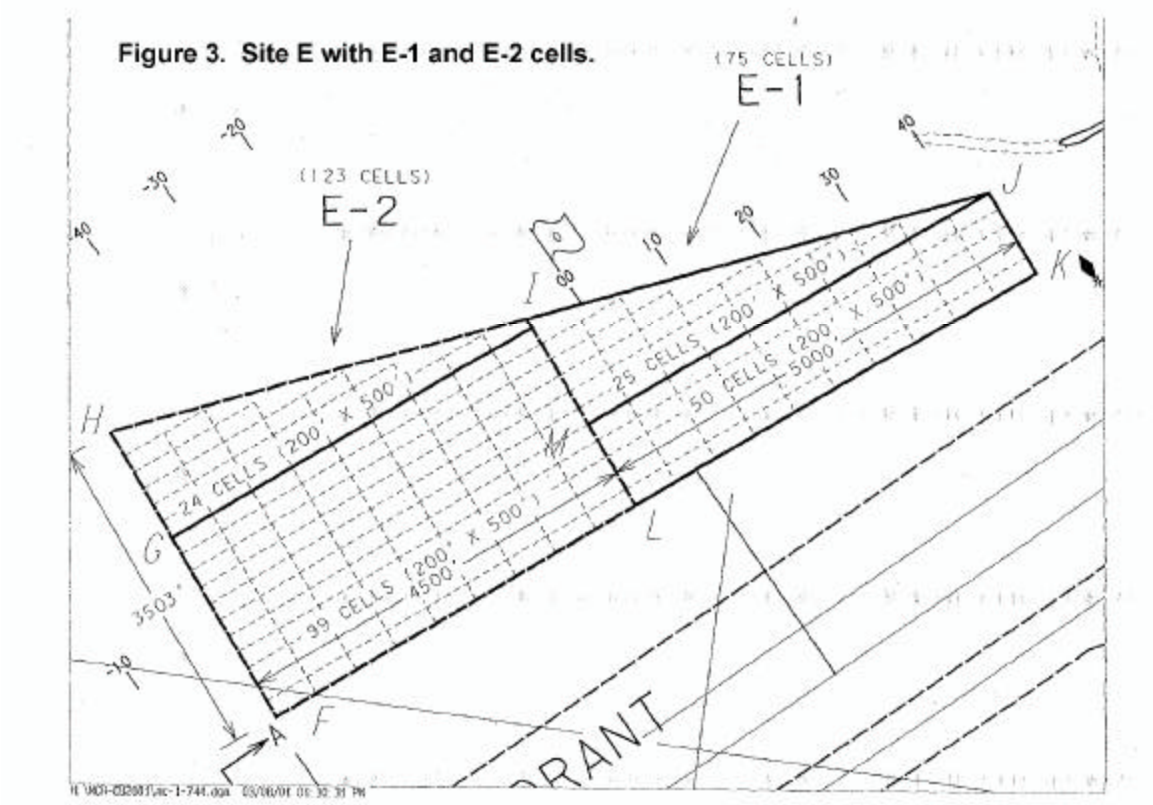


Figure 3. Site E with E-1 and E-2 cells.

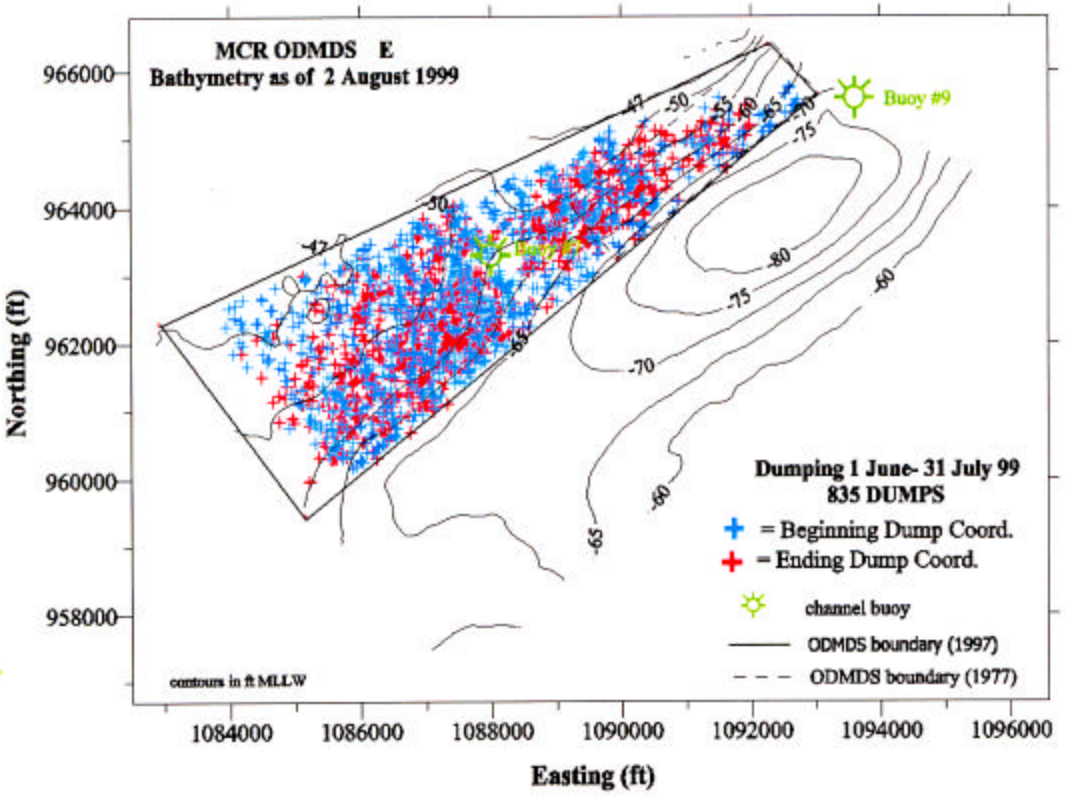
can be hazardous at virtually any time, this is considered to be a prudent practice. Separate disposal zones also help the District to safely maximize disposal in the western ("expanded" or "103") portion of Site E during the limited period when that zone is available for disposal. After August 15, only the eastern area (comprised mostly of the portion designated by EPA as a permanent disposal site under Section 102 of the MPRSA) may continue to be used, subject currently to the limitations of the Settlement Agreement. Finally, separate zones can allow the District to more precisely monitor the effects of different disposal techniques that may be used by or required of the different dredgers, as well as the success of each dredge in achieving site management goals. For example, the degree of mounding caused by different placement techniques, or the degree of erosion following placement, can be better tracked when dredgers do not use the same area at the same time. For these reasons, the Review Team recommends that separate zones within Site E continue to be specified by the District when more than one operator discharges dredged material at the site.

2. DIFFERENT DISPOSAL PRACTICES WERE ALLOWED IN THE SEPARATE ZONES

Site E Placement in the E2 (Western Zone). A contract is let each year for MCR dredging and disposal in Site E2 for approximately 1.5 mcy. To achieve the management objective of even dispersal of material with minimal mounding, Site E was divided into cells (Figure 3). Site E1 was divided into 75 cells and E2 into 123 cells. Comparisons of disposal in 1999 and 2001 for the contract hopper dredge show clearly the attempt to

maximize disposal within the site boundary (Figures 4a and 4b). Note avoidance in the northern portion of E2 and the center of E2 in 2001. Both areas had significant accumulations in 2000, which had not significantly eroded, by the May 2001 survey. As a result, these areas, as well as the separation region between E1 and E2, were identified to the contractor prior to disposal as areas of no placement (Figure 5).

Figure 4.a. Contract Disposal Site E in 1999.

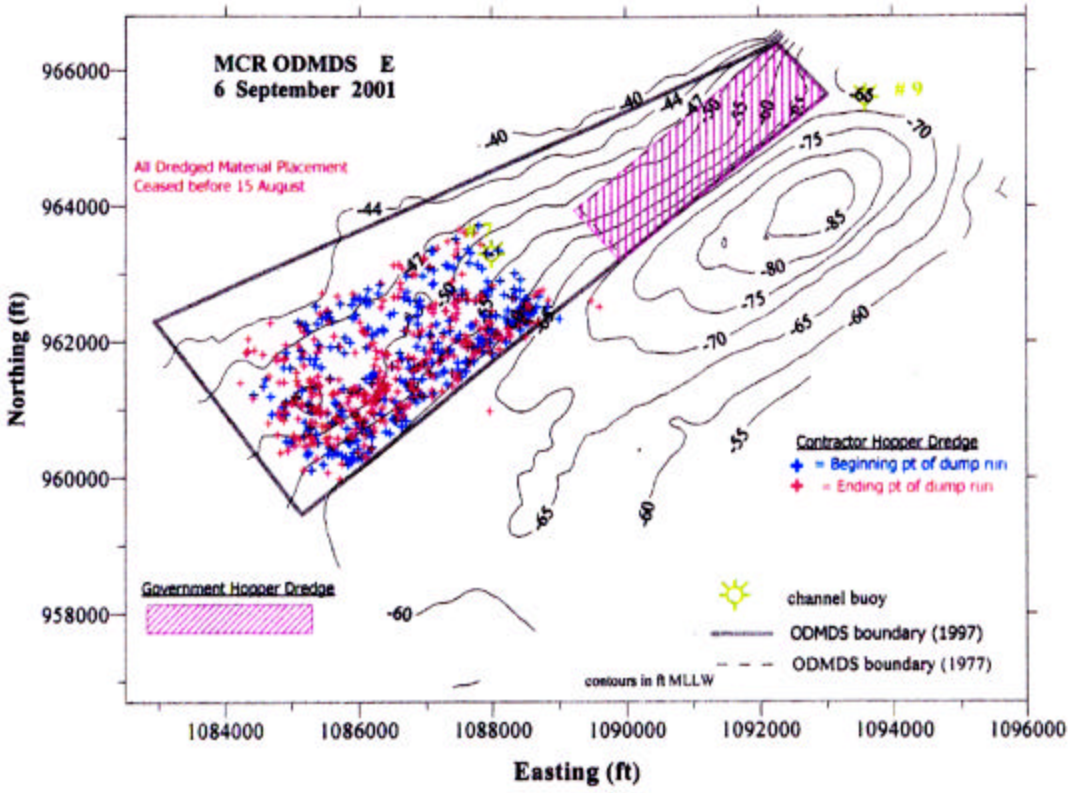


A comparison from May through August of 2001 for E2 indicates a fairly good spread of material over E2 to the vertical management limit of 5 feet. Another comparison between July 30 and August 19 difference plots shows how quickly the site reached capacity, and illustrating the need to have tight triggers on all disposal as the site reaches capacity (Figures 6a and 6b). The areas that exceeded the five foot management limit are illustrated in the figures with a bold yellow line in figure 6a and a bold blue line in figure 6b.

In addition to direct accumulation at the point of disposal, secondary accumulations due to sediment migration within the site were also observed. All contract dumping in E2 in 2001 was from a split haul hopper dredge with a high discharge rate (1-5 minutes). When comparing the differences plots to the discharge plots, it is observed that wave and current dynamics play a significant role, especially along the northern portion of E2.

Although no discharge occurred along the northern cells, a significant portion of this area nevertheless reached the plus five feet level. The use of modeling may be able to assist in the prediction of sediment transport and would be a good tool in optimizing site capacity in conjunction with the existing surveys.

Figure 4.b. Contract Disposal Site E in 2001.

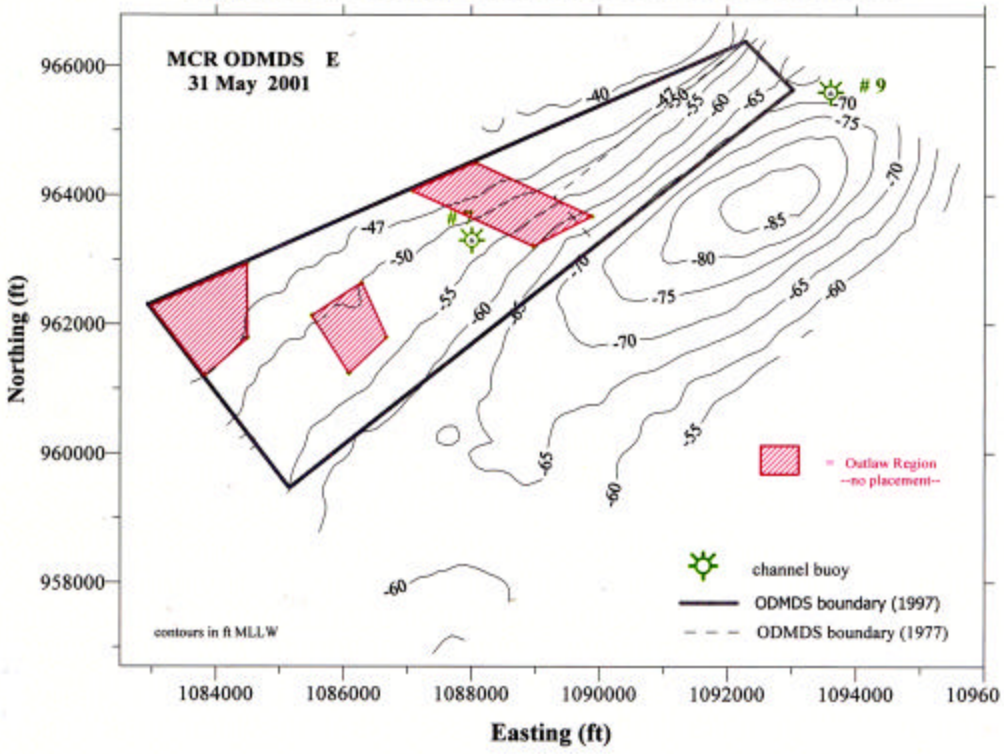


Last, it was noted that portions of E2 exceeded the 5 foot limit after the completion of dumping at E2 (Figure 7). As in previous figures, the area exceeding the 5 foot management limit is outlined. However, Site E2 seems to be very well managed and with a few minor exceptions identified above, was at optimal use (given the management targets in place). As will be addressed in further detail in another section of the report, the Corps should address the issue of altering the 5 foot limit so that the government does not appear to be in non-compliance where there is no real safety issue.

Site E Placement in E1 (Eastern Zone). The eastern portion of Site E was used by the COE Dredge *Essayons.* In place of the cell approach used for the contract dredge, the Dredge *Essayons* received periodic directives on areas to avoid and had the same management objective of maximizing dispersion throughout the site and avoiding mounding. In interviews with the vessel masters, it was quite evident that the vessel masters understood and believed they were attempting to achieve these objectives. A

series of vessel plots for June and July 2001 show the intense disposal at E1. Similar to E2, E1 also had areas identified for no disposal. The northern portion of the site was eliminated as well as the far eastern portion. In fact, in reviewing track lines for 2001, the track lines indicate that disposal was heavily skewed toward the channel side of the landward end of Site E (Figure 8). The figure shows typical track lines for the dredge *Essayons* taken during June 2001. By June 30, 2001 it was obvious from the difference plots that a significant mounding was occurring above the 5 foot limit (Figure 9). However, the June 30 survey was not reviewed immediately, and the *Essayons* continued to follow a similar path for much of July. The August 13, 2001 difference plot indicated a significant elliptical mound in E1. Neither the northern nor eastern portion of E1 was optimally used during the summer of 2001.

Figure 5. Site E with outlaw areas for contract dredge.



A review of placement at E1 in 2000 indicated a broader use and coverage of the site. The coverage of the site was further west and north in 2000. In both years, almost no use was made of the eastern portion of Site E1 nor the southeastern section.

It was not clear from discussions with the District management as to why E1 and E2 placement coverage was significantly different. E1 had a cell grid developed in 1999 and used in 2000 but not in 2001. It would appear that a better dispersion system could be developed for the *Essayons.* Rather than the cells, we would recommend a series of lanes the vessel could use to optimize placement. Also, the vessel masters clearly did not feel comfortable using the northern and eastern portions of the site because of sea conditions prevalent there. If portions of the site could not be used due to sea conditions

or for other reasons, it is suggested that the calculations of capacity at the site reflect those conditions. The Review Team also recommends that, as long as multiple dredges operate concurrently at Site E, they should be managed to similarly specific standards regarding placement location, and they should receive a similar degree of District oversight.

Figure 6.a. Site E difference plot for July 30, 2001.

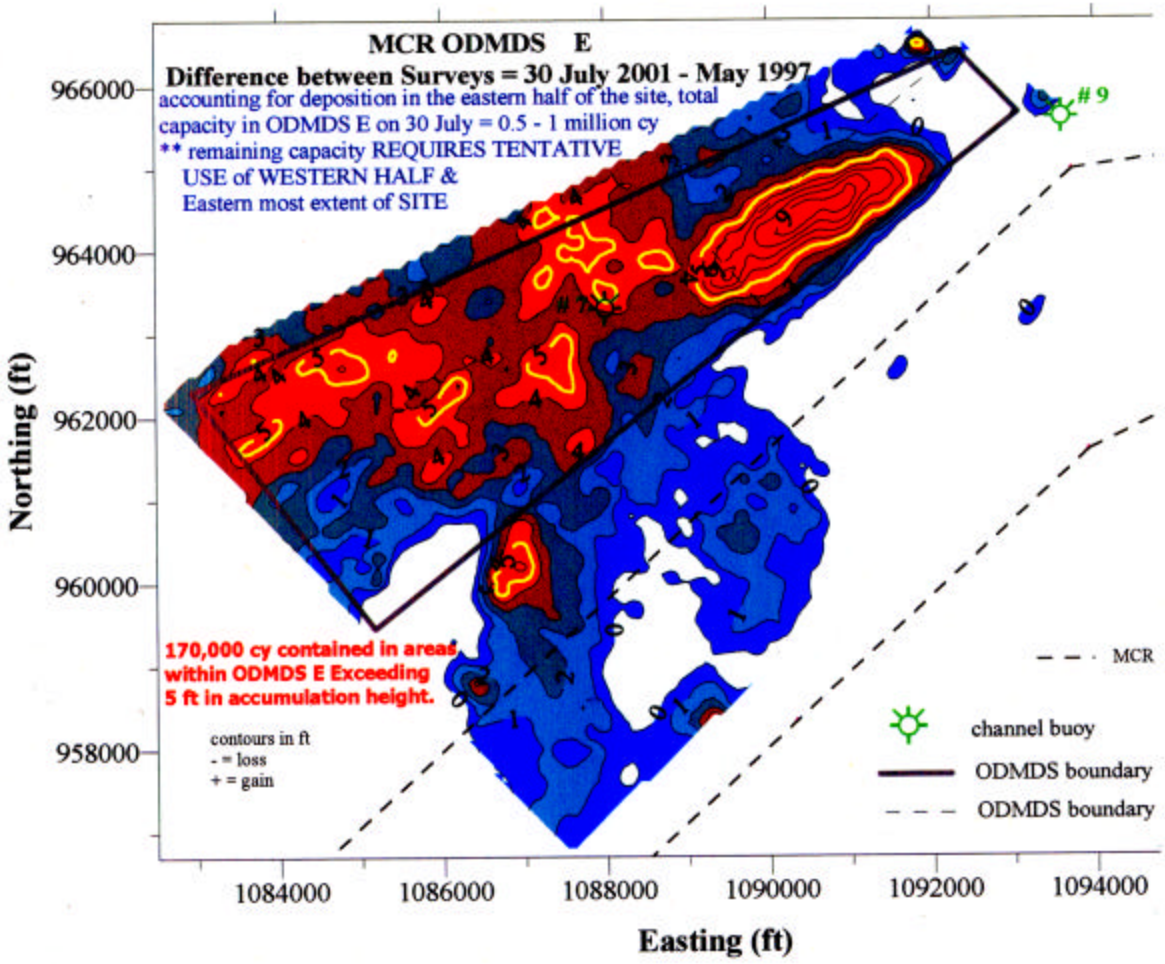


Figure 6.b. Site E difference plot for August 19, 2001.

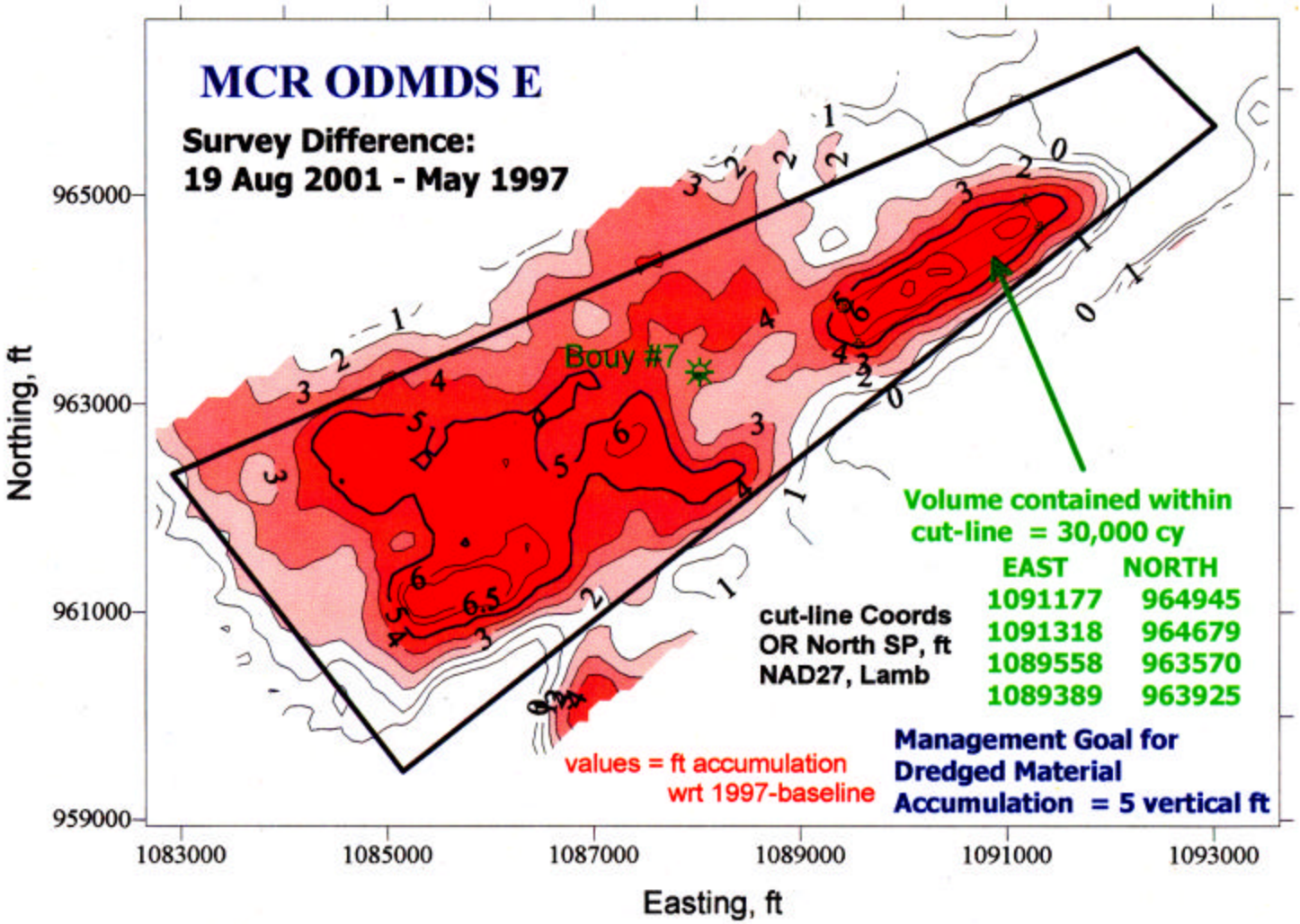


Figure 7. Difference plot for August 27, 2001.

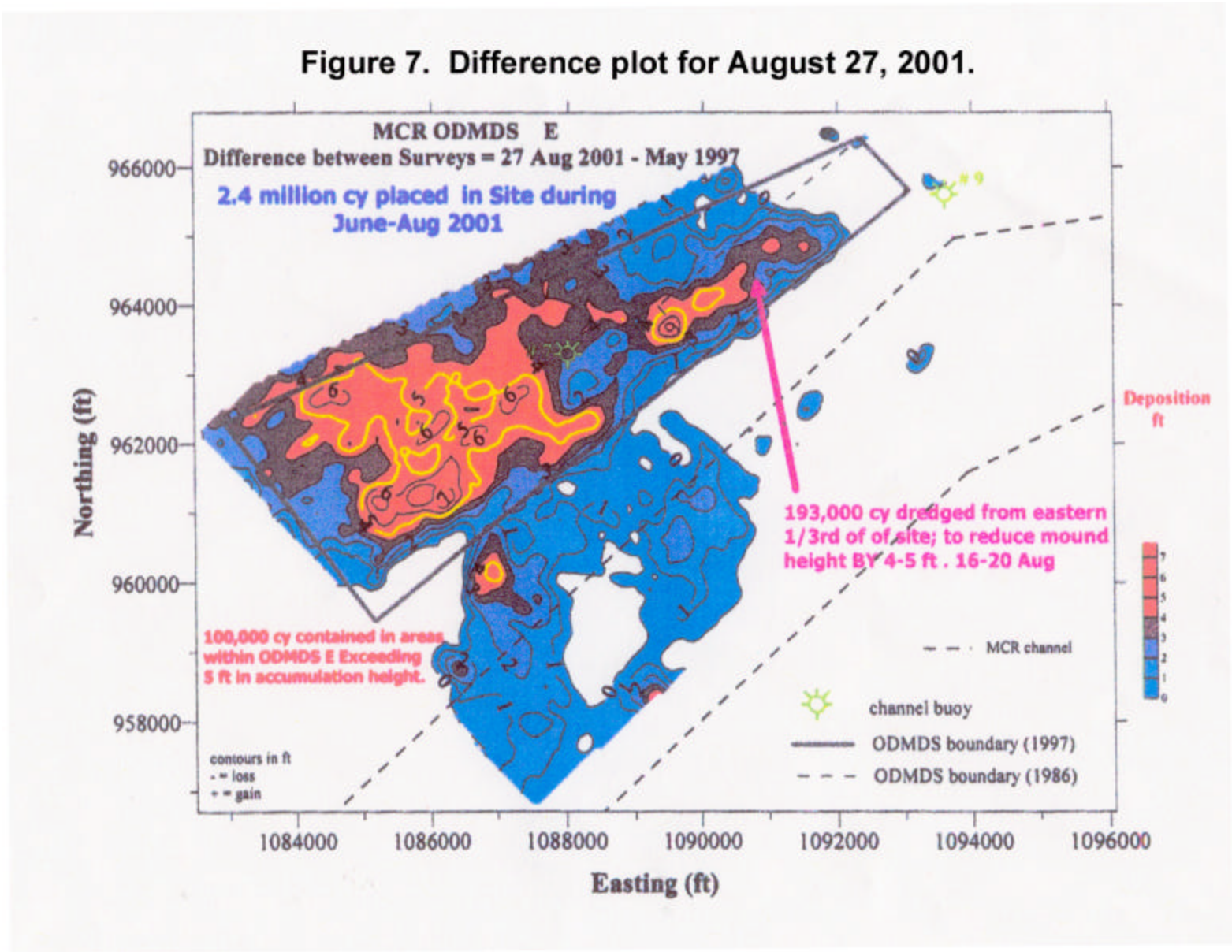


Figure 8. Vessel *Essyons* track lines for June 15-18, 2001.

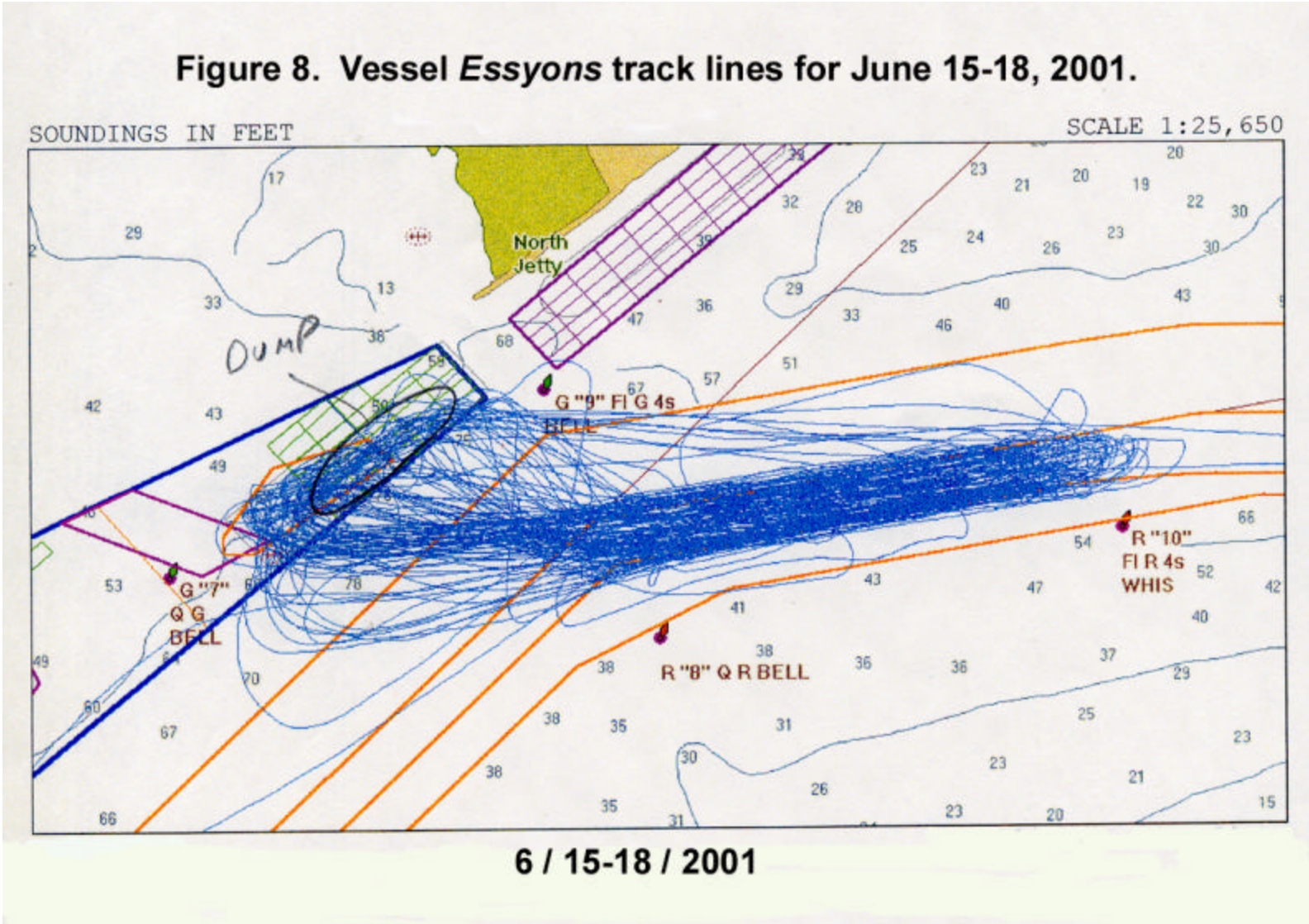
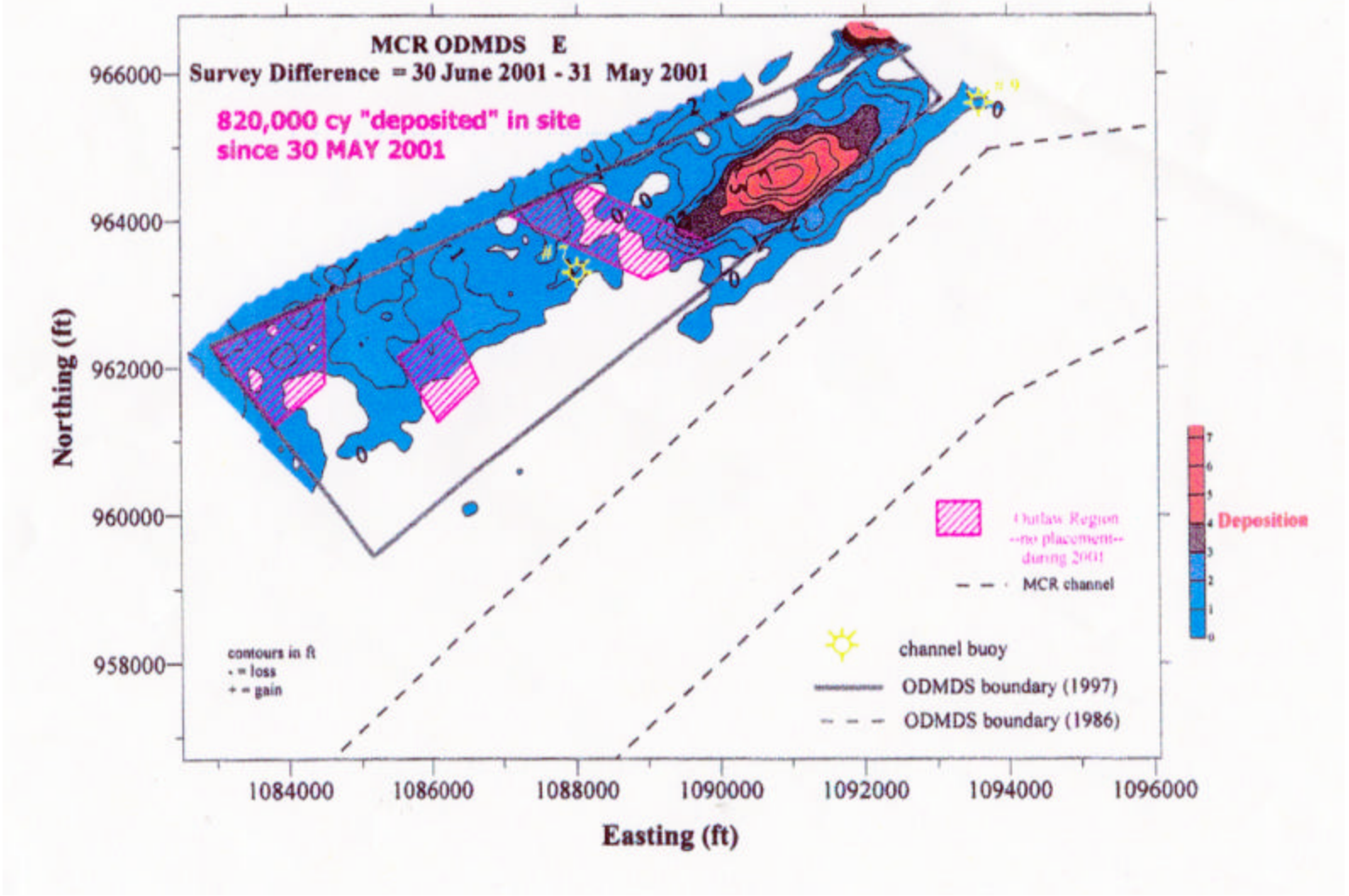


Figure 9. Site E difference plot for June 30, 2001.



2. Record keeping and reporting differed between the contract and USACE dredgers

In addition to the contract dredge having a detailed disposal pattern specified for it by the District, the contractor was also required to provide a report to the District identifying the precise disposal locations as determined by a real-time satellite tracking system . Although similar data were collected routinely by the USACE dredge, there was no requirement that these data be supplied to the District (The data were available however, and were provided immediately to the Review Team upon request.). This highlights the need for better feedback between District managers and the vessel. If disposal tracks for the USACE dredge had been made available to District personnel in a routine and timely manner, the focused disposal being conducted by the USACE dredge could possibly have been recognized and monitored, and perhaps corrected, before excessive mounding resulted. The Review Team recommends that the same kinds of information and reporting requirements apply to both contract and USACE dredging and disposal operations at MCR, that those records be turned into the District frequently during operations, and that District personnel managing the MCR O&M project closely and expeditiously review those records in order to make any necessary adjustments in a timely manner, to best achieve the disposal site management goals.

3. Frequency of disposal site surveys

Condition surveys were conducted very frequently (approximately every 48 hours) as part of the contractor's dredging and disposal operations at Site E. However, such frequent surveys were not conducted as part of the operation of the USACE dredge. The first operational condition survey of the eastern portion of Site E in which the USACE dredge was placing material in 2001 did not occur until 30 June, nearly a full month after disposal there had begun. By this time, approximately 900,000 cubic yards of dredged material had been discharged into the easternmost portion of the zone. Further, the results of this initial condition survey were not reviewed by District staff and converted into the "difference plots" used to monitor for mounding (as defined by the District's interpretation of the Settlement Agreement) for another twelve days (At the time, only one District employee was capable of generating these plots; that employee did not receive the initial survey results immediately, and was unavailable when they were finally provided.). Therefore, spatially focused disposal continued in this area for several days after the initial survey occurred, adding additional sediment before District staff had the information to take appropriate site management action (see Figure 2 and text box). The length of time that elapsed between condition surveys, and the time it took for District staff to generate the "difference plots" from the initial survey, contributed to the mounding in the eastern portion of Site E, and subsequently to the urgency in issuing the Record of Decision. More frequent condition surveys right from the beginning of disposal operations could have detected the focused mounding that was occurring before it became severe. The Review Team recommends that ways to obtain more frequent surveys in the *Essayons* disposal areas (like those conducted every 48 hours for the

contractor's operation) be explored; that the frequency increase especially whenever it is known that triggering conditions are approaching; and that the District increase its capacity for rapidly preparing difference plots (if these will continue to be relied upon) by either training additional staff or obtaining contractor support. To avoid undue cost increases, advantages and disadvantages of requiring the contract dredger's survey vessel

Summary of Surveys, Reports, and Key Events for Summer 2001 at Disposal Site E

Essayons disposed of all material from June to July 15 in the southeastern part of Site E. By end of June 900,000 cy dumped at Site E.

* June 30 Survey first detected mounding above the 5 foot threshold in eastern portion of Site E. Report July 12.
* July 19 survey detected additional mounding.
* July 30 Report and notification to Agencies on July 19 survey with differences plots, which indicated site exceedances up to 12 feet.
* *Essayons* was moved off site on July 14 although did use western portion of site July 30 – August 3.
* July 31 survey. Report on August 3rd provided notification that a 9 foot mound still existed although some erosion had occurred. The management option of dredging was identified.
* August 7 *Miss Brittany* sinks.
* August 9 notification of mound still exceeding 5 foot threshold and options of dredging becomes more apparent. Estimate of 200,000 cy at Site E above 5 foot limit.
* August 9-13 upper level management decision to dredge with minimal consultation with EPA – draft ROD and e-mails were sent to EPA. There appears to be some misunderstanding of site authority at Site E.
* August 13 Survey and August 14 Report which did not show substantial change.
* August 15 ROD formalized.
* August 16-20 *Essayons* dredged at Site E1 and removed 193,000 cy and redeposited in Site F.
* August 27 Survey shows mound removal at eastern portion of Site E.

to regularly submit soundings for all active disposal areas should be considered.

D. Management of Site E

In the Review Team's opinion, management of Site E should focus on balancing the goals of keeping dredged material in the near shore zone against the need to *not unacceptably increase risks* to vessels transiting the area (in contrast to a hypothetical goal of *providing for* vessel safety). Peacock Spit has been undergoing substantial long-

term erosion throughout the last century (Figure 10). It is unlikely that erosion of the Spit or the up-coast shoreline could be completely eliminated even if all the sand dredged for MCR O&M were to be placed at Site E. However, any sand placed there (and at the Jetty site) will help to retard the *rate* of sand loss from the system. At the same time, it is unlikely that even complete elimination of the use of Site E would substantially reduce existing risks to vessels transiting the area, because Peacock Spit would continue to exert a predominating influence on wave climate there for decades to come.

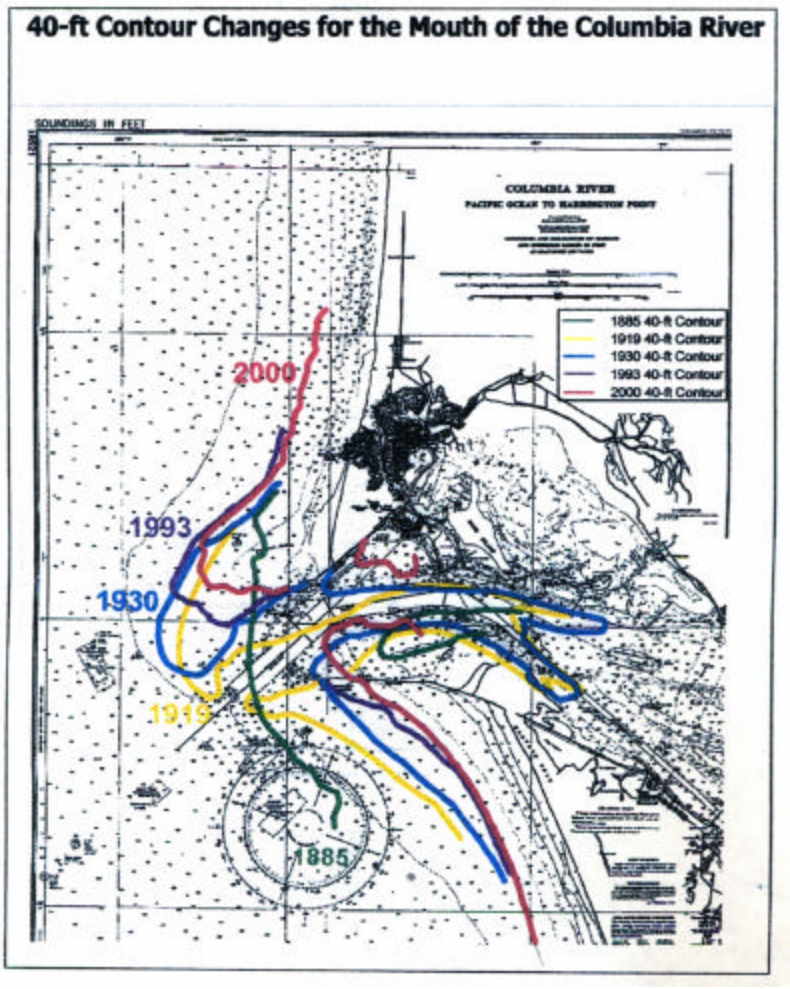


Figure 10. Historical erosion trends of Peacock Spit.

The parallel goal of minimizing potential seasonal impacts to Dungeness crab is at odds with both of the above, primary goals. Potential crab presence in the deeper, western portion of Site E has led to a restriction on disposal there after August 15. This ensures that even more emphasis must be placed on the smaller, shallower eastern portion of the site in order to meet disposal needs (if as much material as possible is to be kept in the littoral system). This eastern portion of the site is, in turn, where the most focused mounding has occurred, and has resulted in perceptions about negative impacts to navigation safety. If the entire site were available longer, there would be more flexibility

to manage the site in such a way that retention of sand in the littoral system could be maximized, and at the same time mounding effects minimized.

In order to place the maximum amount of sand at Site E for dispersion to the near shore zone without unreasonably increasing risks to vessels transiting the area, the District and EPA Region 10 must actively manage the site in accordance with site use parameters or standards developed specifically to address these issues. (The Settlement Agreement imposed one standard on site use, but the specific standard it uses, or at least its interpretation/implementation, does not necessarily relate directly to the site management goal as discussed in a later section) . In particular, any measurement or indicator of risk to vessels transiting the Site E area must reflect the reality that Site E lies immediately adjacent to (essentially on the south shoulder of) the existing, shallower, Peacock Spit. In other words, vessels transiting Site E south to north also must transit Peacock Spit. Mounding due to dredged material placement at Site E is highly unlikely to be the driving risk factor for vessels transiting this area unless and until that mounding is so severe that Site E effectively becomes the "high spot" of Peacock Spit itself along the transit route (The provisions of the Settlement Agreement indirectly ensure this would not happen, but other more meaningful methods for achieving the same goal could also be devised. See Wave Modeling Section.).

The Review Team believes that recent management of Site E has been getting out of balance. The District's interpretation and implementation of the Settlement Agreement is potentially jeopardizing its ability to accomplish the basic mission of maintaining the federal navigation channel at the MCR, even though there has been no apparent real or substantial increase of risk to vessels. As described below, the Review Team believes that Site E can be managed differently, and can probably accept more dredged material, while remaining in full compliance with the Settlement Agreement and without unacceptably increasing risks to vessels.

1. SITE E MANAGEMENT OBJECTIVES AND THE MMP

As noted earlier, there is limited capacity at the other available disposal sites in the vicinity of the MCR. Therefore, Site E is presently critical to the District's mission of maintaining the federal navigation channel at the MCR. Site E also represents the primary means by which sand dredged from the navigation channel can be managed for the ongoing objective of retaining it in the near shore littoral system. At the same time, Site E is in an area widely known to be one of the most hazardous anywhere in the U.S. for vessel movement. It is also in or adjacent to a particularly heavily used and high value resource area. For these reasons Site E is already (and appropriately so) the most intensively managed ODMDS in the District.

The most up-to-date version of the MMP is the appropriate document to look to for particular management objectives, monitoring approaches, monitoring "triggers", and specific management actions to be considered based on monitoring results.

The 1998 MMP does provide a good general discussion of:

* the need for clear and specific management objectives;

* the benefits of tiered monitoring, and the role of performance predictions and hypothesis testing in the monitoring program;

* the need to identify evaluation questions and monitoring-based "triggers" for management action; and

* the need to identify a range of management actions that can be considered.

The MMP discusses each of these needs for the MCR sites. However, the information presented is not sufficiently detailed to serve as an adequate guide for the kind situation that arose at Site E in 2001.

The first of the MMP's Management Practices (page 1-10) states, *"Dredged material will be distributed between sites to reduce the potential for mounding. Alternate sites can be used if sea conditions, traffic, or other uses make one of the sites undesirable."* But the assumption behind even this first management practice is not completely valid: even though Sites A and B were deactivated years earlier, the range of alternative sites actually available for routine use is not reflected in the MMP.

The MMP has also not been updated to reflect the requirements of the Settlement Agreement, which was finalized several months after the MMP was prepared. For example, it is unclear whether the Settlement Agreement supersedes the action triggers and management responses listed in Table 2-1 of the MMP. This table lists the 5-foot depth change (that has continued to be used at Site E) as the action trigger. However, it specifies that this depth of mounding must occur over 50 percent of the site for two years in order to trigger a management response. This does not appear to be the same "trigger" that led to the "re-dredging" decision in 2001, even though the Settlement Agreement does not appear to impose an alternate "trigger" (or any specific "action").

Finally, the 1998 MMP does not clearly reflect the importance now placed on reducing the rate of long-term erosion of Peacock Spit, and retaining sand in the near shore littoral system as required by the State of Washington's Water Quality Certification. Instead, the MMP (page 1-9) states, *"The primary management concern at the Columbia River ODMDS is to avoid mounding at the sites. Significant and persistent mounding can result in adverse wave conditions causing a potentially hazardous situation to navigation. A secondary concern is the potential for sediment to migrate back into the navigation channel."* There is little or no mention of Peacock Spit, the littoral system, or the State of Washington's beneficial use requirement anywhere in the MMP. We recommend updating the 1998 MMP to reflect the current situation, as well as to provide necessary detail currently lacking (see "Need to Update the MMP" below).

2. SETTLEMENT AGREEMENT

In 1998, plaintiffs including the Columbia River Crab Fisherman's Association (CRCFA) challenged the temporary expansion of Site E (and of Site B). The parties reached a Settlement Agreement in June 1998 (supplemented in September 1998)

allowing these sites to continue to be used under certain conditions. In particular, disposal cannot occur in the western 5000 feet of the Site E expansion area after August 15 in any year (to minimize impacts to crab that may be in the area after that time), and the USACE must *"make every effort in their disposal of dredged material at Site E to avoid disposal in a way that contributes to wave amplification greater than 10 percent."* However, the Settlement Agreement also states, *"Nothing in this Stipulation affects, limits, or prevents … disposing dredged material within ODMD Sites B, E and F as designated in 1983 … (or) within the inner portion of expanded ODMD Site E"* (i.e., management of the original "102" Site E is not affected). According to an internal memorandum (U.S. Army Engineer District, Portland. 1998), USACE agreed to continuation of these restrictions because adequate short-term capacity existed (through the 2000 dredging season only), using all disposal sites available, to fully meet the maintenance requirements of the MCR's federal navigation channel. The Settlement Agreement's stipulations expire when the USACE's "103" site expansions expire in July 2002, and in any event they do not necessarily extend to management of new disposal sites designations that may occur in the future.

3. Recent Site Management Limitations Based on the Settlement Agreement

In the Review Team's opinion, several aspects of the Settlement Agreement, its conservative implementation by the District, and the language used in the "re-dredging" Record of Decision (ROD) have adversely and perhaps unnecessarily affected both site management and public perception regarding Site E.

The Settlement Agreement's "10 percent change" standard. The "10 percent change" standard in the Settlement Agreement apparently arose from the particular computer model being used by the District ("RCPWAVE") to predict potential wave amplitude changes. The 10 percent value was reportedly considered to be akin to the "noise level" of the model (in other words, above this model-predicted level some degree of real change was likely). An apparently tacit assumption was that this equated to an indicator of "no discernable change." Use of the 10 percent standard therefore effectively reflects a conservative "precautionary approach" to site management, whereby any degree of discernable change in wave amplitude is considered undesirable. However, it is a major leap to connote that an indicator of "any discernable change" is also an indicator of an actual "impact" (i.e., that an increased risk to vessels transiting the area would in fact result from this degree of change). It is a similarly major leap to conclude the inverse: that no measurable change due to disposal at Site E means the area is generally *safe* for vessel transit. Either conclusion is likely to be erroneous because of the overwhelming influence of the adjacent Peacock Spit on the area's wave climate, whether or not any material is disposed at Site E.

The District's estimate of mound height that could cause a 10 percent change. At different water depths, different mound heights are required to create a 10 percent change in amplitude for the same design wave. Site E ranges in depth from approximately 45-70 feet. However, a single factor (5-foot change in bottom depth) was used for simplicity as the indicator of whether mounding, at any depth, could result in a 10 percent change in

wave amplitude. This factor was felt to be convenient to track[1], and was used to help determine whether the computer wave model should be run using the actual bathymetric data. However, there was no particular definition of what kind of exceedance should necessarily trigger further management action (e.g., how much above the 5-foot trigger, over how large an area, and for what period of time?), or what kinds of management actions would be triggered. In any event, the Settlement Agreement did not mention the 5-foot value, or any other particular indicator. Therefore other approaches could have been followed. For example, we note the same actual wave amplitude would result from a 10-foot mound at an original bottom depth of 60 feet (i.e., with a mound crest at 50 feet) as from a 20-foot mound at an original bottom depth of 70 feet (also with a mound crest at 50 feet). The *location* of the peak wave amplitude could be slightly different, but the peak wave amplitude itself would be similar. And that peak wave amplitude would still be less than that caused by the much larger and shallower feature immediately to the north – Peacock Spit. In reality, dredged material deposited at the sloping Site E does not represent a discrete mound, but rather a relatively minor broadening of the existing southern shoulder of Peacock Spit.

The computer model used to predict whether the 10 percent change standard would be exceeded. On several occasions when bathymetric surveys showed that the "trigger" of a 5-foot change in bottom depth had been exceeded, the District ran a computer model to predict possible wave amplitude changes. However, the Settlement Agreement does not mandate this particular computer model be used. Other models available today and considered to be more realistic (e.g., "STWAVE") could provide a more accurate picture of wave changes (see Wave Modeling discussion, below). Under certain conditions, use of this more realistic model might have indicated that mounding at Site E was not "out of standard" relative to the Settlement Agreement, and re-dredging (or indeed any other management action) might not have seemed as urgent.

The "re-dredging" ROD. The ROD language unfortunately seemed to reinforce the connotations and tacit assumptions reflected in the Settlement Agreement and the District's conservative implementation of it. In particular, the ROD solidified the perception that *any* mounding over the management target of 5 feet was "excessive" (in contrast to the "Action Trigger" published in the MMP that was ostensibly still in force). Furthermore, the ROD noted the District's intent to re-dredge, but provided no discussion of other potential alternatives (except "no action"). The Settlement Agreement does not mandate re-dredging, or in fact any particular management action, if the 10 percent "standard" is exceeded.[2] Unfortunately, both the language of the ROD and the fact that

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1 However, we note that use of this factor (rather than, for example, a target bottom depth that could be read directly from the condition surveys) contributed to the mounding in 2001, due to the delay before the "difference plots" used to depict this factor could be prepared.

2 In fact, the Settlement Agreement states, "Nothing in this Stipulation affects, limits, or prevents" the USACE from disposing material within the original, EPA designated "102" area of Site E. This is precisely where the *Essayons* was discharging material in 2001, and where the majority of the mound that was subsequently re-dredged occurred.

re-dredging was chosen without discussion about other potential actions, may reinforce erroneous public perceptions concerning:

1. whether Site E was in fact "out of compliance" with the Settlement Agreement (which is questionable);

2. if it was, whether it created a safety hazard (which is also questionable); and

3. whether re-dredging should be expected in the future in similar circumstances.

Such public perceptions can have adverse effects not only on continued use and management of the existing disposal sites, but on future designation and management of proposed new disposal sites in the area as well.

Existing management of Site E has therefore arguably become more much restricted than required by the Settlement Agreement. At virtually every step in the management and decision trail, conservative approaches have been followed. The 10 percent standard is being measured – or rather *indicated*, since direct wave monitoring is not being done - by conservative metrics (the single 5-foot depth change coupled with the RCPWAVE model). Any exceedance of these conservative indicators is being considered excessive, and to imply unacceptable risk to vessels, without any information to support that an actual hazard would result. Finally, it has been taken to indicate the need for the most drastic management response – re-dredging – if a substantial exceedance appears (by conservative measures) to have occurred. Given the limited capacity of the other existing disposal sites, these somewhat self-imposed restrictions at Site E could result in insufficient disposal capacity for maintenance of the federal channel at the MCR, particularly in years with higher than average shoaling.

4. NEED TO UPDATE THE MMP

The Review Team strongly recommends that the District and EPA Region 10, working closely together, re-evaluate and update the existing MMP for disposal sites used to maintain the MCR project. (EPA was not a sufficiently engaged participant in the chain of events during 2001. Since there are implications to the existing 102 sites E and F, and particularly to future EPA "102" designations, Region 10 should be much more actively involved in any management decisions concerning use of the ocean disposal sites in the vicinity of the MCR (see the Communications section below). Improvements can be made that we believe should be in full compliance with the Settlement Agreement while it remains in force, while still providing for more flexible management, a potentially greater disposal capacity, and no significant increase in risk to vessels transiting the area.

The joint EPA/USACE re-evaluation and update of the MMP should:

a. Be based on an explicit confirmation and articulation of how the various site management goals and public interest factors (including slowing erosion of Peacock Spit, slowing erosion of up-coast beaches, minimizing

impacts to Dungeness crab, not unacceptably increasing navigation risks, and maintainingsufficient capacity for necessary dredging operations) are being balanced

b. Include a clear federal (USACE/EPA) interpretation of the specific requirements of the Settlement Agreement (while it remains in force)

c. Include specific, agreed upon monitoring principles, methods, and measures that are relevant to the management goals (and Settlement Agreement requirements)

d. Continue to follow a Tiered approach that directly relates to specific site performance predictions and evaluation questions

e. Specify the kinds of management actions that could be triggered in different circumstances

f. Reflect the resources in each agency that are realistically available to carry out the site management plan

Possible management actions that could be triggered in different circumstances range from "no action", to more intensive evaluation or more frequent monitoring, to modifying the disposal plan (e.g., by "rotating" placement zones), to institutional controls (such as publishing temporary/seasonal warnings to small vessels, or establishing a web camera showing real-time wave conditions at the MCR), to re-dredging as a worst case. We acknowledge that the range of actions is broad and the possible circumstances that could indicate the need for some management consideration are essentially infinite. A prudent, adaptive management approach includes retaining enough flexibility to respond appropriately to changing conditions. We therefore recommend the management plan list the kinds of actions that would be considered, but that it not be overly prescriptive.

More intensive versus less intensive site management approaches. The final point regarding agency resources in the list above is central to the kind of management approach that can realistically be applied at the MCR. There are logically two main approaches that can be taken (with a range of modifications and permutations possible between the two). The first approach would have as its primary goal maximizing sand retention in the near shore littoral system, through intensive management of disposal at Site E and the Jetty site. This approach is the most resource-intensive. It includes using all available means to maintain detailed, real-time operational control of dredged material disposal. This means, for example, combining detailed pre-disposal planning, high-resolution disposal placement tracking and reporting for all dredges, frequent condition surveys, rapid survey data processing and decision making, and timely communication of any needed changes back to the dredges. Timely coordination with EPA and stakeholders should occur throughout the process, and redundancy in staff technical capabilities should be available at each stage. Although resource-intensive, such a system is necessary to provide for the maximum volume of material to be placed at these two dispersive sites over the course of the dredging period, while remaining within

whatever specific management parameters (bottom depth, mound dimensions and persistence, etc.) have been established.

The opposite approach could be necessitated if agency resources were the primary limiting factor. If the kind of real-time adaptive management discussed above is not possible, less material could be reliably placed at Site E and the Jetty site while remaining within the site management objectives established. For example, capacity for the season could be based on the pre-disposal condition survey only, and the dredging specifications and orders would be written accordingly ahead of time and not changed. The ability to place additional material, equivalent to that which erodes from the sites during the dredging season, would be lost. Therefore less sand would be retained in the near shore littoral system, and greater reliance would have to be placed on the limited capacity at Site F (until new 102 sites are designated by EPA). This could potentially mean that insufficient aquatic disposal capacity would exist to fully maintain the authorized dimensions of the MCR federal channel, especially in a heavier than average dredging year. However, even under this approach, we believe that re-evaluation of the specific management practices and measurements at Site E could allow somewhat more material to be placed there than would otherwise be the case.

E. Communication

Good communication and efficient information flow, both internal and external, is always important. But the need for full and efficient communication takes on far greater importance where intensive management is necessary to achieve goals. The competing objectives for operation of Site E have established the need for intensive management. In many ways, communication within the District, and between the District and its external stakeholders, is already good. However, improvements can be made to both internal and external communications to help ensure that the management goals at Site E can be successfully achieved.

There were several points during 2001 when problems with communication and information flow affected management at Site E. (These are separate from problems noted elsewhere concerning information *collection*, such as the frequency of condition surveys.) The Review Team recommends that the District, and EPA Region 10 as appropriate, evaluate any structural or organizational issues that may have contributed to these communication and information flow problems, and develop means to address them.

1. INTERNAL

* The District did not communicate specific placement locations to the USACE dredge, as it did for the contract dredge, leading to different placement approaches being used by each

* The District did not require the placement data collected by the USACE dredge to be reported back, leaving District staff unaware that focused placement was occurring

* There was a substantial delay before the first during-disposal condition survey was provided to appropriate staff for further processing

* The lack of a written or detailed plan outlining the kinds of management actions that should be considered in various mounding scenarios, contributed to poor communication between technical staff and upper level management, particularly after media and political pressure became more intense following the *Miss Brittany* accident

2. INTERAGENCY EXTERNAL

* The District did not always clearly recognize the distinctions between actions and authorities at the EPA-designated "102" portion of Site E, versus the expanded "103" portions of the site; therefore they did not always coordinate sufficiently with EPA Region 10

* The MCR is not necessarily a high priority area for application of EPA resources, the way it is for the District; Region 10 staff have not been available to coordinate with the District to the extent necessary under an intensive management approach to Site E

* Region 10 was unaware of the actual volume of sand placed at site E until interviewed by the Review Team

* Although Region 10 concurred in the re-dredging ROD, there had been insufficient coordination leading up to the ROD, and insufficient time available at that point, to fully consider implications of the action or of the ROD language to ongoing management at Site E or to future 102 site designations

F. Wave Modeling

The characteristics of nearshore water waves depend on the characteristics of deep-water waves arriving from offshore, local wind, bathymetry, and currents. Hence, changes in water depth change wave characteristics. Portland District adopted a well-known, monochromatic wave model, RCPWAVE, to examine the potential that waves might be amplified by placement of dredged material in MCR disposal sites. The choice of which model to use and the methodology of evaluation are reasonable choices for initial testing of whether the vague criterion given in the Settlement Agreement (SA, Section D-2) is likely to be exceeded.

The SA criterion is vague because it makes no reference to how the change in wave amplitude is to be determined. Is the baseline for definition of change referenced to the pre-disposal depths for the year in question or for some other condition? It is not practical to measure wave changes directly over the areas of concern. So, presumably the planning and verification that thresholds were not exceeded has to be based on modeling with perhaps some short-period spot measurements. Yet the SA does not specify how

this modeling is to be done. Neither is any definition given of what would constitute exceedance in terms of the conditions, area, or time for which the waves are to be evaluated.

1. RCPWAVE MODEL

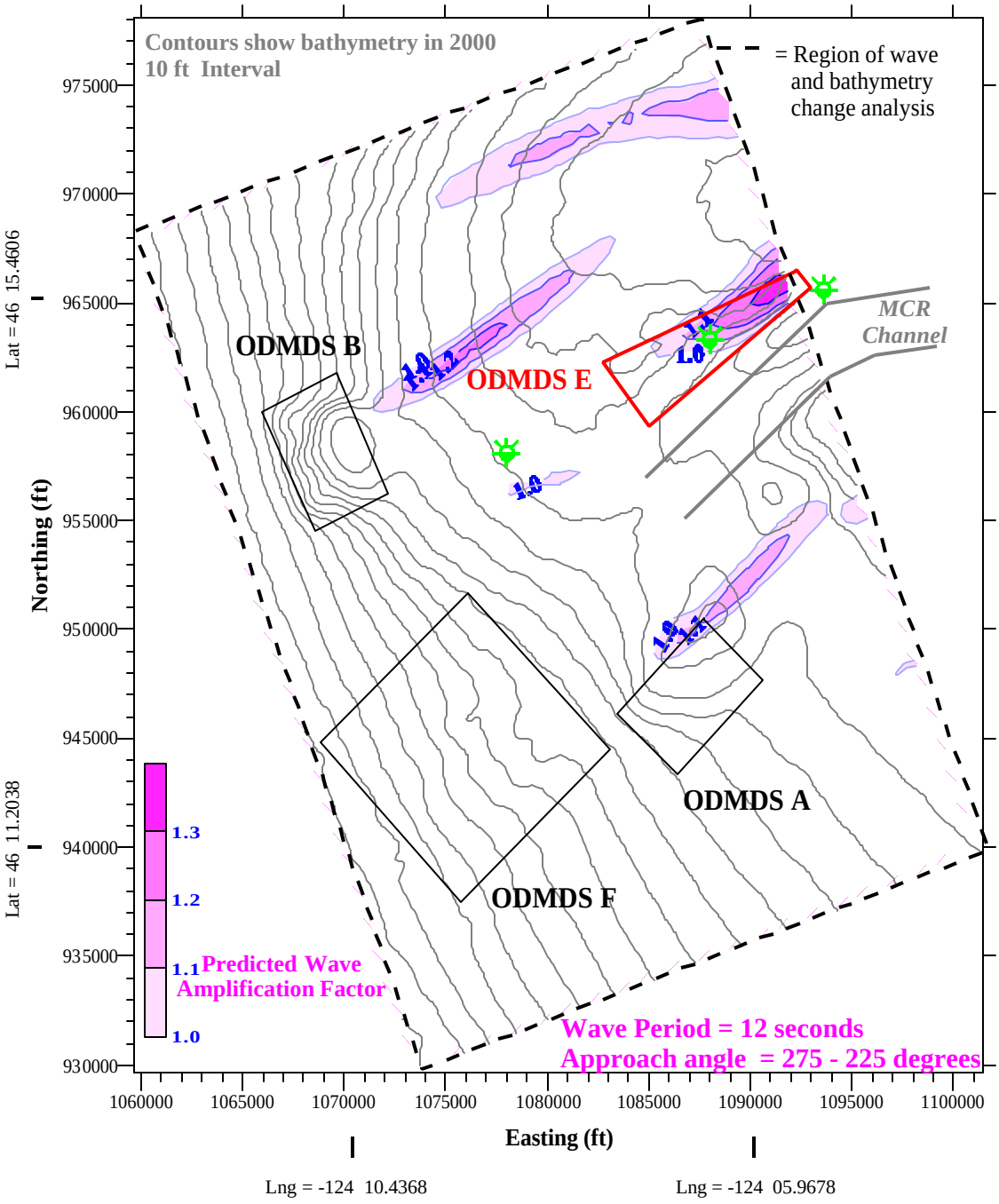
RCPWAVE (Ebersole 1985; Ebersole, Cialone, and Prater 1986) is a monochromatic wave transformation model. The wave field is composed of uniform waves, i.e., all of the same height, period, and direction. RCPWAVE is a widely used engineering tool that calculates evolving wave characteristics (height, period, and direction) as a wave propagates out of deep water, moves shoreward, and finally breaks in depths equal to about the height of the wave. Wave characteristics within the model vary in space, but not in time. The theoretical basis for RCPWAVE was established in the 19th century, but linear wave theory is still the most widely used theory for many engineering applications including operation of wave pressure gauges, and estimation of rates for alongshore sand-transport and shoreline change. RCPWAVE overcame problems with earlier wave ray refraction models that failed where waves appeared to cross in areas of nonuniform bathymetry like Site E.

There are more sophisticated, time-dependent, shallow water spectral models that better represent more extreme refraction and diffraction and other features of wave transformation. These later models are required if results are to approximate mechanisms like wave reflection. wave-wave interaction, nonlinearities, steep bottom slopes, wave-current interaction, input of wind energy, and the nonunifomity of waves in height, period, and direction. Models that consider these complexities require denser numeric grids, greater computer resources, and more experienced interpretation. Such requirements presently make the more complex models generally beyond routine management use. Furthermore, RCPWAVE usually overestimates the increase in wave height (Smith and Harkins 1977) that occurs as a wave moves into shallow water. Thus RCPWAVE is conservative and appropriate as a screening tool to identify thresholds for concern in situations like Site E.

2. STWAVE MODEL

STWAVE (Resio 1993) is probably the most widely used of the more sophisticated PC models. STWAVE goes beyond RCPWAVE by including bottom friction, percolation, wind input, and nonlinear transfers of energy. This last feature makes the results more realistic especially over complex bathymetry, like Site E, were monochromatic models over estimate the focusing effect of the bottom. Examples of the differences can be seen by comparing RCPWAVE results with STWAVE results (Figure 11). The over focusing of energy by RCPWAVE is not as apparent in figure 11 as would otherwise be the case because many results from rerunning RCPWAVE for a large number of wave directions and periods have been combined ad hoc to produce a single picture of amplification much as repeated film exposures can capture a single image of many situations. NWP developed this method of overlapping monochrome wave results as an improvement in applying RCPWAVE to estimate whether the accumulation of placed material was causing significant wave amplification.

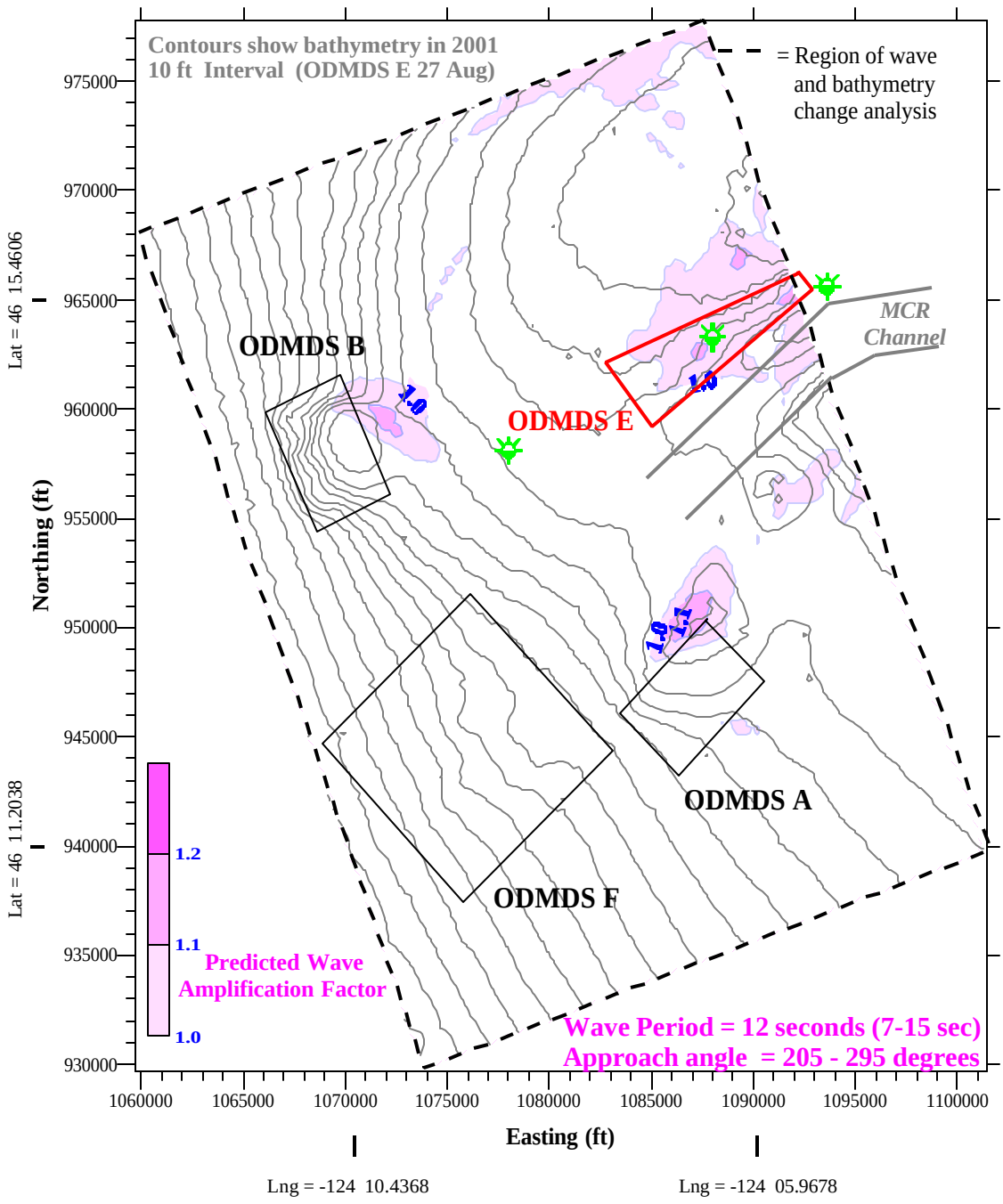
STWAVE can also handle wave-current interaction and wind input, but these features were not applied when obtaining STWAVE results for comparison with RCPWAVE. Figure 12 is a representative example comparing NWP's standard RCPWAVE results with STWAVE results obtained at ERDC in September. Including realistic estimates of wave-current effects would have changed the results substantially. Waves steepen when opposed by a current. In this case ocean waves are steepened by ebb currents and flattened by flood currents. This fact is well known and the basis for avoiding the bar during ebb tide when seas are high.



RCPWAVE Model Results

Figure 15

Figure 11. RCPWAVE model estimate of potential for increased focusing between 1997 and 2000 (Figure and modeling by NWP).



STWAVE Model Results

Figure 12. Spectral estimate of potential focusing for similar conditions as input to monochromatic model shown in previous figure. Amplification shown here are for all waves input to RCPWAVE and in addition to waves from more southerly and northerly sectors. In spite of the additional waves, STWAVE does not indicate amplification as intense as RCPWAVE. The contours shown are for 2001, but the bathymetry input to both models was identical (nominally 2000 and 1997)

3. Limited Area of Influence

The amplifications shown in Figures 11 and 12 are due to natural and dredge-related bathymetric changes. Figure 11 shows four large areas of change. It is safe to say that all but the most northerly of these amplification areas are due to dredged material disposal. The most landward of these three areas occurs because of the material placed in Site E between 1997 and 2000 . The other two are because natural changes eroded southern sides of the prominent dredged material mounds at Sites A and B and moved this material to the north over this same period. The lateral extent of amplification tends to be exaggerated by RCPWAVE. Note, however, that disposal in E created a potential for amplification above 10% that extends no more than 2500 ft outside of Site E. Natural accretion on the north portion of Peacock Spit created a potential amplification area much larger than did the bathymetric changes in Site E. In the longer run, the purpose of returning sand to the littoral system is to reduce erosion of the sub-aerial beach and the submerged portion that supports it. Over many years, as tens of millions of cubic yards of sediment are kept in the littoral system, the hope is that this action creates a significantly wider shore than would be the case if dredged material were taken out of the littoral system. We do not expect these much larger changes will create any boating hazard because safe navigation requires awareness of actual sea conditions, not hypothetical ones that would have existed if erosion had proceeded unchecked.

4. Recommendation to Detach Considerations of Wave Modifications from Dredged Material Disposal Decisions

Problems with Increasing Wave Height. A finite amount of wave energy arrives inshore from deep water. Through interaction with the bottom, the wave properties are transformed as energy propagates shoreward. In the present context, it is important to recall a fundamental principal, different bottom configurations rearrange the spatial distribution of wave heights across the nearshore zone. Waves peak over certain (shallow) areas and diminish where wave breaking dissipates energy. Wave heights also decrease in areas that are deprived of the energy that is focused instead onto shallows. Wave height changes depend on the exact bottom configuration, but the wave energy flux summed across the whole nearshore zone is never amplified by interaction with the seafloor regardless of how shallow, deep, or rough. At locations where energy is focused, wave heights increase and in adjacent areas, heights decrease. The simultaneous combination of wave amplification/reduction can be seen, for example, in Figure 13.

Vague SA Condition, Difficult To Measure And To Model. Even if there were only a single wave height, period, and direction in deepwater, the irregular bathymetry of Site E would create varying wave conditions across its surface. It is not practical to measure continual variations over an area the size of Site E even at much less energetic field sites. Even for research purposes, field measures would be few and modeling would be employed to interpolate spatial variations. There is no unambiguous method to determine if the SA criterion is exceeded because there is no specification of the exact location and

size of the area where modeled waves must be large, for what time span, by what model, what modeling procedure, and for what bathymetric, wind, tide, and incident wave conditions. In each case where these ambiguities suggest different interpretations, the District choose to follow the conservative interpretation that favored minimizing wave changes even when that interfered with other disposal objectives. The following subheadings summarize further problems in applying the SA wave amplification criterion even if its vagueness were to be reduced.

Multiple theories. Engineers use a hierarchy of wave theories. To varying degrees all theories are simplifications of known real world variations.

Multiple models. Models used to apply each theory add an additional layer of abstraction or idealization. Figures 11, and 12 illustrate the magnitude of differences obtainable with just two of many possible models. RCPWAVE does not model as many features of wave transformation as does STWAVE and typically over estimates the height of refracted waves as seen in Figure 11.

Model input uncertainty. Wave height at a given time and location is a function of several usually poorly known independent variables some of which change substantially with time:

(a) 3-D bathymetry (not just scalar representation of depth).

(b) Simplified incident waves (rather than range of sea conditions).

(c) Wind can modify the wave directly and through wave current interaction.

(d) Tide has a major effect of wave height, length, speed, and steepness.

(e) Wave-wave interaction.

Most coastal engineering applications allow modeling errors exceeding 10 percent and compensate for them with conservative margins of safety. The SA's focus on 10 percent wave amplitude has complicated dredging and has questionable actual benefits for safety.

Incompatible Objectives. Dredging is the primary tool that Corps uses to provide for safe navigation. Through a long process, involving work by many agencies and other public representatives, Site E was designated a disposal area for dredged material. Dredging of disposal areas is prima facie evidence of disposal area mismanagement. In the case of Site E, this alleged mismanagement seems to be a direct result of attempts to compromise two contradictory uses. Deep-water sites can be managed to meet simultaneous navigation and disposal uses at the same time. The value of Site E, however, is that it is located where vigorous waves and currents will disperse the placed sediment, returning it to the naturally dynamic prism of beach sand.

If the volume of dredged material placed in Site E were to be restricted based on a requirement not to change wave patterns, then no sand should be placed in the authorized disposal site. In other words, any use of the Site will change the bathymetry and thus alter the wave transformations to some degree temporarily. Therefore, the claim could be made that the inevitable future boating accidents in this hazardous area would not have occurred except for the disposal that either elevated or at least reshaped the seafloor. A logical counter argument would be that prudent boat operation requires that the skipper respond to actual, not hypothetical, wave conditions and that frequently the response would be to avoid Site E regardless of whether dredged material had been placed there or not.

During storms natural sand movement can cause elevation changes in excess of 20 ft (Hands, 1999). Build up of the seafloor caused by placement of dredged material over a full dredging season at Site E has not occurred. Skippers must be ever vigilant in this region *because large and steep waves cannot be predicted.*

Compromised Channel Maintenance. We have discussed the need to not reduce options to place material in Site E. Actually, greater than past use of Site E seems necessary, along with designation of the Deep-Water Site and exploration of ways to place sand directly on adjacent beaches in order to maintain the practice of dredging 3 to 5 M cy from the entrance annually. These options are discussed further in a later section.

Limited Measure of Boating Hazard. The SA limitation, that dredged material placement not result in more than a 10% wave amplification, was accepted to help resolve a lawsuit brought against the Corps by the CRCFA. The CRCFA were concerned about potential increased risk to boats in the vicinity of Site E. Interviews and documents indicate that NWP initially felt this criterion would not limit their use of Site E nor have an adverse impact on their ability to maintain safe conditions in the MCR navigation channel (e.g., U.S. Army Engineer District, Portland. 1998). Through a series of modifications and reinterpretations (and loss of alternative placement sites) the SA led to adoption of a depth change threshold, then a depth change limit, a management decision to dredge Site E, and finally to a management policy that significantly limits dredging options and, it seems to us, threatens continued maintenance of the navigation channel.

Not only did the SA led to a situation jeopardizing safe channel maintenance by restricting disposal options, but also it offered no objectively measurable risk reduction for vessels choosing to traverse Site E. There are several ways Site E placement criteria could be changed that would permit placement in Site E while limiting any increase in hazards to boats in the area. Better placement criteria could eliminate vagueness. The criteria could be directly related to changes in hazard seas for specific areas. Standards for applying the criteria could be developed that would permit objective identification of whether the criteria were met or violated.

If, however, a decision is reached that tolerates no increased hazard at any time for boats traversing Site E, then there is no way to prove that placement of any amount of material, no matter how small, does not violate this strict limitation. Placement raises the

bottom elevation. In such a shallow location as Site E, raising the bottom will modify wave characteristics and among other things increase the wave height and steepen waves.

Real Hazard on Peacock Spit. The large natural shoal off MCR is Peacock Spit (Figure 10). It is a chronically eroding remnant of the pre-jetty ebb shoal. Ebb shoals are naturally occurring deposits that occur at inlets and estuary mouths wherever tidal and wave forces oppose one another. They usually take the form of a crescentic bar. For most of the last century the former ebb shoal has been eroding (Figure 10) creating deeper water to the northwest of MCR. The deeper water allows larger unbroken waves to impinge on the tip of the North Jetty. Damage to the jetty is increasing not only because of greater wave exposure, but also eventually because of undermining as the jetty foundation becomes threatened. If unchecked erosion would eventually provide deep water and thus might appear to offer future improved navigation conditions for boats turning north just beyond the jetties. Disposal in Site E slows these processes, but helps maintain jetty stability. Under present conditions and even if erosion of Peacock Spit proceeds to the point of jetty collapse, the hazardous wave conditions for boats taking a shortcut to northern areas would not be encountered in Site E, but a mile or more to the north on Peacock Spit as illustrated by the large area of wave breaking shown in Figure 14. Our other wave-related figures shows changes in wave conditions compared to 1997. Figure 14, in contrast, shows actual as well as changed conditions. The modeled waves did not break in Site E in 1997, but did along a small portion in 2000. In both years, however, there were large areas of breaking to the north. This breaking was not a direct result of any disposal (Figures 11 and 12). If a vessel were to avoid the large area of breaking on Peacock Spit, Site E could also be avoided with little or no added transit time to or from nearshore areas to the north.

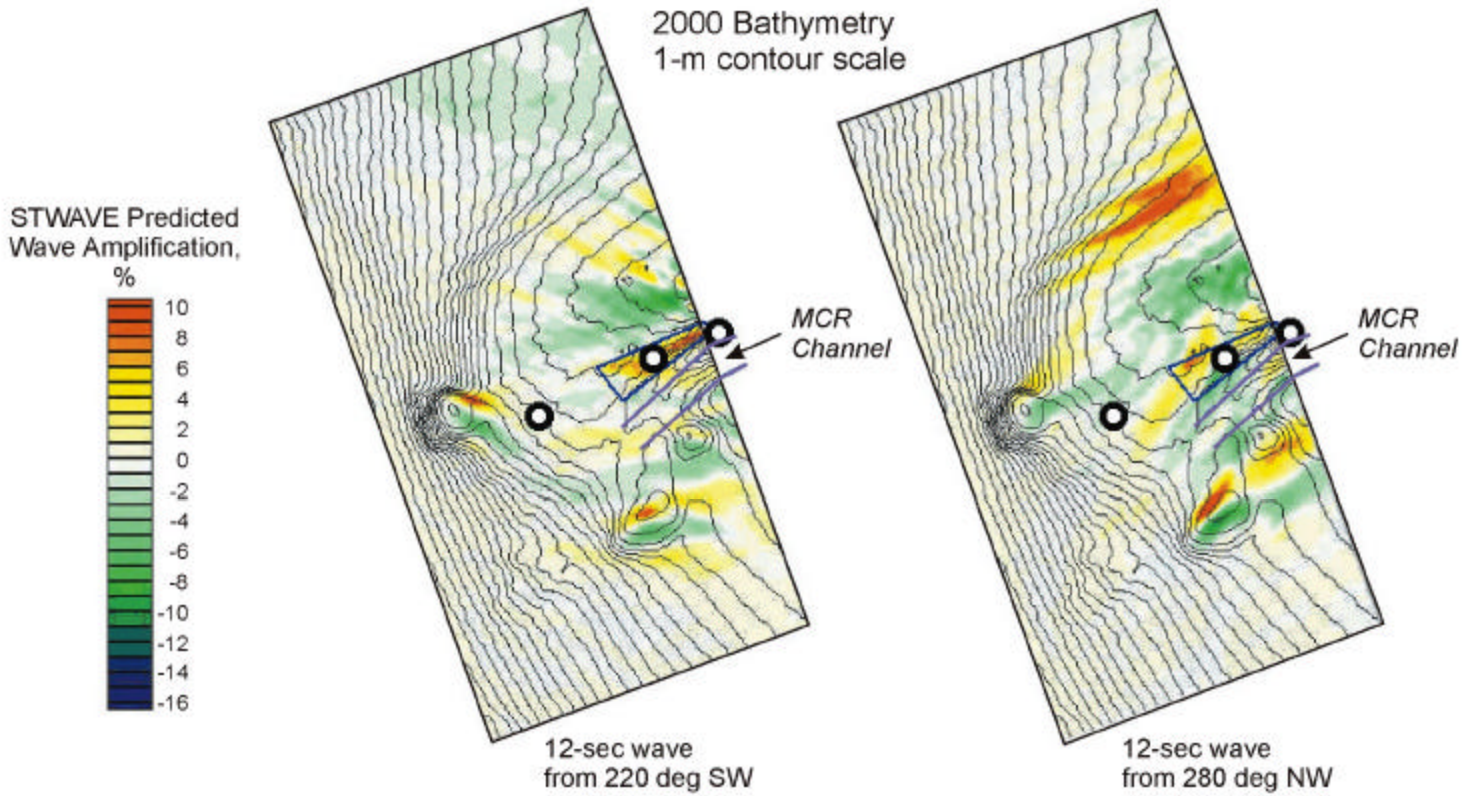


Figure 13. Model results of where wave heights increase and decrease for a particular incident wave field and bottom configuration.

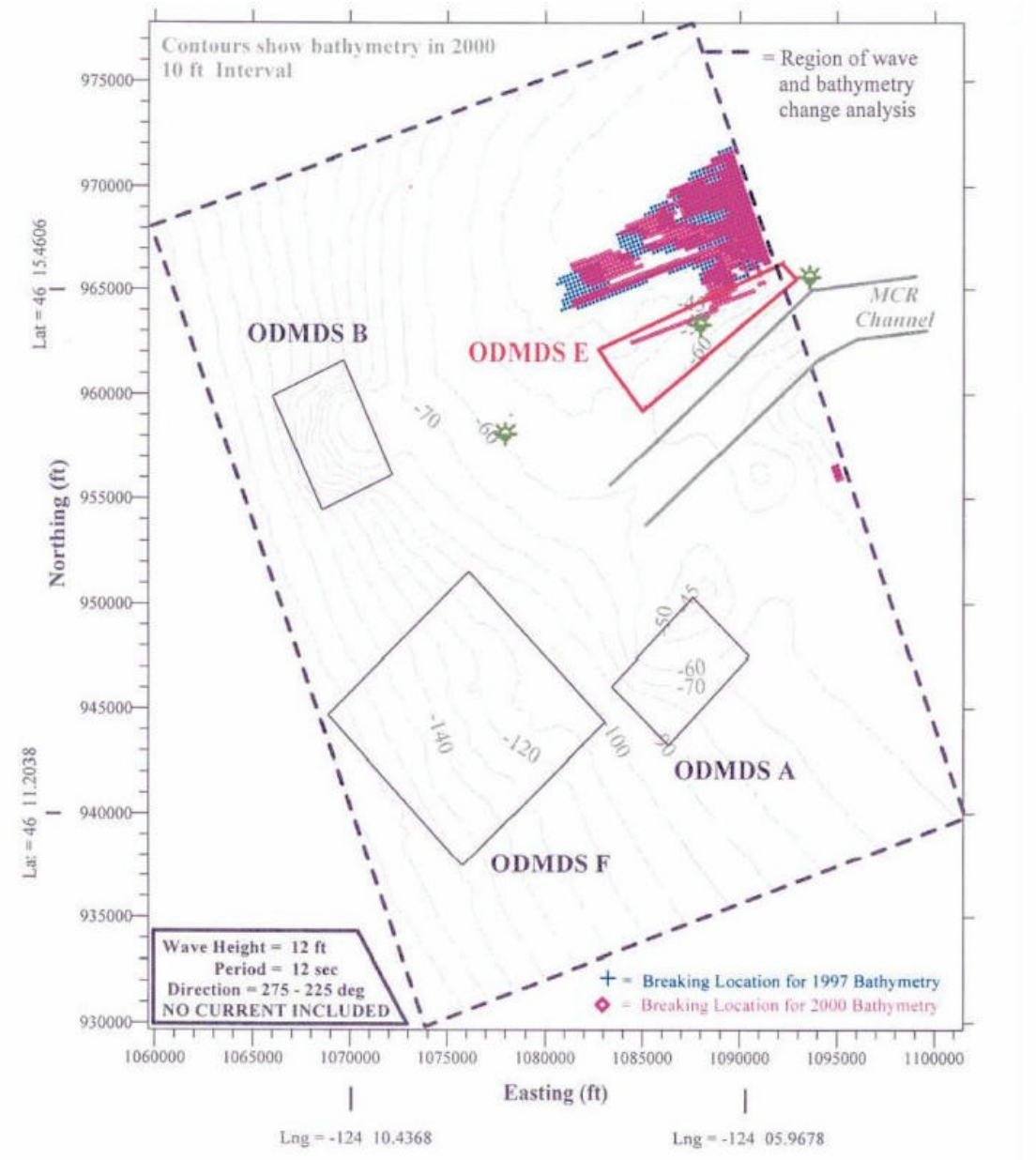


Figure 14. Predicted areas of wave breaking in 1997 and 2000.

5. Recommended Review Of Site E Objectives

Assurance that disposal contributes in no way to the danger of traversing Site E, would probably mean abandoning any use of the site. Therefore we see only limited realistic disposal options that have no potential to impact safety, serve navigation needs, and meet environmental goals (Table 1).

Table 1
Dredged Material Disposal Options, Considered In Combinations In Text

Number	Option	Estimated Annual Capacity, Mcy
1	Site E with strict requirement of no increased hazard to boats	0
2	Site E with no requirement based on hazards to boats in the vicinity	3-4
3	Site F	1
4	North Jetty Site	0.5
5	Deep-Water Site	> 6
6	Pumping onshore	> 2
Only the first four are presently available, designated sites.		

At least 5 of the 6 options have been addressed in the recently completed EIS (USACE 1999). The EIS considered direct beach placement, but concluded it was too expensive. Considering the limited disposal options and the well-founded forecast of increasing erosion throughout the Columbia River Littoral Cell, it is only prudent to look closely at new options for retaining valuable sand onshore. Options should include innovative designs benefiting from new technology (e.g., the Punaise, Williams and Visser 1998), cost sharing, economies of scale, special allocations with long-term amortization of investments based on knowledge of long-term and growing needs to conserve limited sand resources. From a regional sand management perspective, additional costs to beneficially use dredged material could be much cheaper than late remedial action. There is, in any case, insufficient technical data to make a comprehensive analysis of costs and benefits associated with all promising options. Resolution of competing uses is always difficult, but especially so at MCR where the well articulated desire for safe boating over Peacock Spit directly contradicts its functioning as a designated disposal and beneficial use site.

Resolution of conflicting uses usually requires either a command decision or difficult and lengthy discussions with all interested stakeholders. Without second-guessing the outcome of either approach, the major advantages and problems with each option are summarized in Table 2.

As an alternative to compromising two diametrically opposed goals (use of Site E and boating safety in a shallow hazardous location), investigating whether there would be other supportable ways for the Corps or other agencies to help reduce boating accidents in the vicinity of Site E while its use as a disposal site continues. Modification, even

elimination, of Site E use might arguably have a minute positive effect, but it could also be argued that this would encourage risky traversing through a dangerous area. In his testimony, Captain Neal Nyberg, Master of the *Essayons*, volunteered that whatever the conditions in Site E, they are always better in Site E than farther north on Peacock Spit.

One example of more effective measures to reduce risk for those fishing Peacock Spit would be to maintain some mechanism like web-reporting wave and current gages and/or video cameras that would provide information of sea conditions that could be assessed remotely. The feasibility of modeling to develop forecasts and nowcasts of sea conditions, wave steepness, and/or probability of sneaker waves are other examples of steps that might be taken to improve boater safety.

Table 2
Major Advantages And Disadvantage Of Disposal Options

Number	Abbreviated Option	Advantages (+) and Disadvantages (–) under present arrangements
1	E, No wave amplification	+ Reduced liability exposure for boating accidents, but no less real hazard. - Loss of disposal site and erosion mitigation.
2	E, Without wave-based limitation	+ Beneficial and efficient use of DM. + Likely to diminish rate of Peacock Spit erosion - Exposure to liability for future accidents
3	Site F	+ Backup disposal site for maintenance and capacity for deepening. - Irrecoverable loss of sand resources. - Congestion between dredge, waiting pilot boats, and channel traffic. - Limited capacity
4	North Jetty Site	+ Proximity to channel shoaling. - Limited capacity
5	Deep-Water Site	+ Backup disposal site for maintenance, retention of any sediments unwanted near shore, and capacity for deepening. - Irrecoverable loss of sand resource. - Not presently designated.
6	Pumping onshore	+ Direct beach erosion mitigation. + Potential for all-weather disposal, short haul, and flexible beneficial use. - Costs and permits have not been evaluated. - Does not likely diminish rate of Peacock Spit erosion.

The primary recommendation of this team is that the objectives of Site E usage be reevaluated with the recognition that wave amplification limitations do not make traversing the Site significantly safer, but do severely hinder beneficial uses. There is a need for better articulation of where within the site specific elevation changes are important. Further, definition of lateral extent of such changes also needs to be considered. The long-term strategy of MCR dredging operations should be revisited with all stakeholders including the CRCFA as parties interested in preservation of crab and other natural resources.

The following section summarizes observations and conclusions about laudatory aspects of Site management as well as suggestions to modify certain procedures even before overall Site objectives can be clarified or redefined. These recommendations, given in more detail earlier in our report are intended to provide such benefits as increased coordination within NWP and with EPA, earlier and more objective warnings that new placement thresholds are being approached or exceeded, and broader

understandings of the responsibilities and appropriate responses when and if thresholds are exceeded.

V. Summary of Observations and Recommendations

The Review Team makes the following observations and recommendations based on the information we evaluated during our investigation. It is important to note that this report does not address any aspect of causality for the vessel accidents that occurred during the summer of 2001. The Review Team did meet with the US Coast Guard in the course of our investigation to exchange information, but the conclusions of that investigation will be presented in an independent Coast Guard report.

* District and EPA staff are doing a very good job of trying to balance the conflicting site management objectives (e.g., maximum beneficial use, avoidance of mounding and avoidance of the western portion of Site E after August 15th), but this balancing is not explicitly written.
* The District effectively uses many lines of communication providing multiple opportunities for discussion and feedback by all interested parties.
* Frequency and level of involvement with EPA on Site Management decisions needs only minor, but critical improvement.
* The disposal practice used by the *Essayons* in 2001 may have unexpectedly resulted in the mounding observed in the eastern section of the site. Even though disposal primarily occurred in a small, energetically dynamic portion of the site, this likely lead to the mounding observed nearby.
* The Corps dredge crew is knowledgeable of the site management goals and conducted their portion of the work in a way to try to meet these objectives.
* District staff were unaware of this disposal pattern because placement positions were not mapped and reported back to managers and there were significant time delays between surveys and difference plots after completion of surveys.
* The management of sediment placement by Corps dredges needs some improvement.
* The management of sediment placement by contractors is generally well managed.
* The District should include in both Dredge Orders and Contracts specific measures to insure that disposal release points or lanes are appropriately distributed to help avoid mounding and require reporting of sediment release positions in a timely manner.
* The District should take steps to assure that critical tasks (e.g., bathymetric survey difference comparisons) and capabilities have redundancy among the staff and that tight reporting requirements be developed .
* The District should build more deliberate site alternation (e.g., between Sites E, F, and North Jetty) into the annual disposal schedule to provide time to collect, process, and evaluate monitoring data as well as time for natural dispersion of sand off the site during the dredging season. For example, Corps dredge placement could be limited to a specified volume at Site E

whereupon sediment would be directed to North Jetty until a survey of Site E had been conducted and reviewed. Then, based on that information a new interim volume could be allowed at Site E before triggering another survey.

* The District should develop a more realistic approach to initial calculation of capacity available at Site E given that portions of the site are sometimes effectively not available to disposal.
* The District and EPA should develop potential management responses/contingencies to monitoring results relative to site limitations. This could be done by developing Tier 2 and possibly Tier 3 of the monitoring/management approach. This will create better advance coordination with EPA and will also create clearer procedures and potential responses when quick decisions are needed.
* There appears to be good respect and trust between the EPA and the Corps, though the District should consider steps (e.g., training/partnering between different management levels) to increase it.
* The District should lead the development of a joint USACE/EPA understanding of the Settlement Agreement to be concurred with by upper management of both agencies.
* The District should take steps to ensure that there is an understanding throughout the entire management chain of the difference in site authorities, responsibilities, and final decision roles for MPRSA 102 and 103 sites, and how this affects joint management responsibilities and coordination needs is very important.
* The District should assure that EPA is explicitly involved in decisions about seasonal placement volumes at the 102 designated sites.
* Site Management discussions between EPA and the District (at all management levels) should always include the District Ocean Dumping Coordinator.
* Staff, resource, and priority levels at EPA appear to adversely affect both the interagency communication (written and verbal) and the progress on long term disposal site needs. The District should take steps to discuss this with EPA management.
* The District should work with the Coast Guard in developing some real time measurements of sea conditions at the Mouth of the Columbia River especially near the north Jetty and west toward Site E. This would assist the Corps and contract dredges as well as the general public transiting the MCR. One suggestion would be the creation of a real time web site which could include the wave height, picture off jetty, and tide information.
* The District should consider dedicating a survey vessel to Site E during the critical stages.
* The District needs to reevaluate the use of sand bypass systems as one alternative to the use of Site E.
* The District and EPA should, as soon as possible, update the existing MMP. The update should incorporate, as appropriate, the preceding recommendations.

* The District and EPA should proceed, as soon as possible, with designation of new permanent ocean sites capable of meeting the long-term disposal needs of the MCR project.

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